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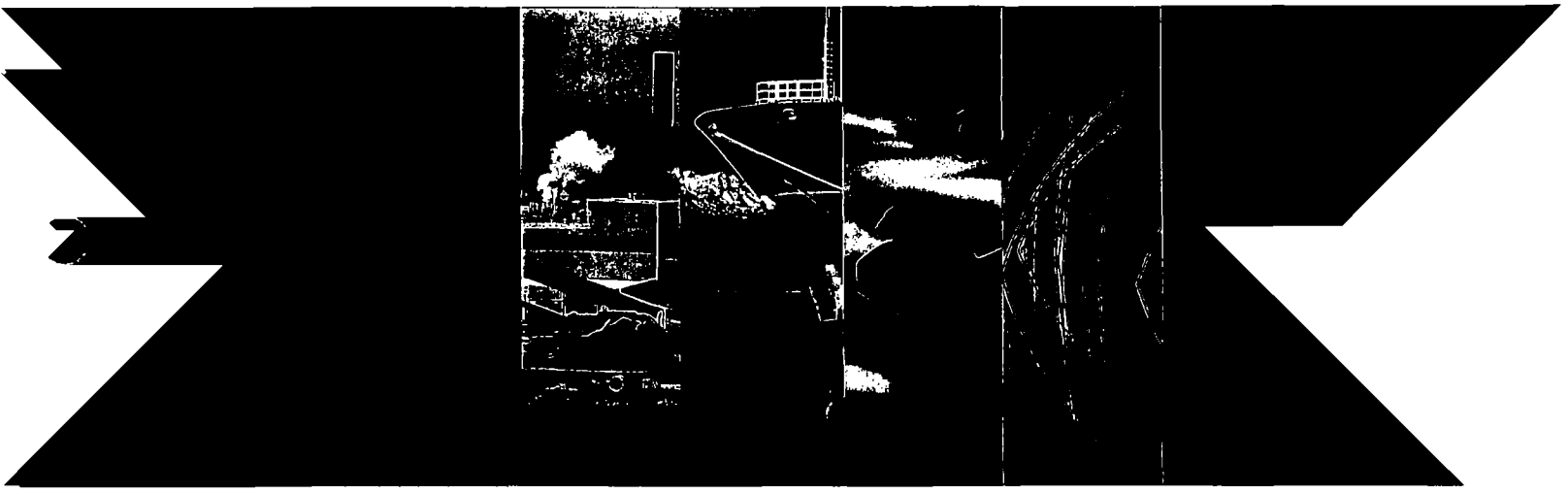
FINAL
ROUND 1B
TECHNICAL MEMORANDUM

for

Middle Waterway Problem Area

of the

Commencement Bay Nearshore/Tideflats
Superfund Site
Tacoma, Washington



prepared for the:

Middle Waterway Action Committee

MIDDLE WATERWAY

Protecting the Environment, Promoting the Economy

August 23,1999

FOSTER WHEELER ENVIRONMENTAL CORPORATION

ANCHOR ENVIRONMENTAL, L.L.C.

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ROUND 1B
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prepared for the:

Middle Waterway Action Committee

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August 23, 1999

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ACRONYMS AND ABBREVIATIONS

AET	Apparent Effects Threshold
Anchor	Anchor Environmental, L.L.C.
AOC	Administrative Order on Consent
CB/NT	Commencement Bay Nearshore/Tideflats
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CST	Column Settling Test
DRET	Dredging Elutriate Test
EF	exceedence factor
EPA	U.S. Environmental Protection Agency
Foss Maritime	Foss Maritime Company
Foster Wheeler Environmental	Foster Wheeler Environmental Corporation
HPAH	high molecular weight polycyclic aromatic hydrocarbon
HSP	Health and Safety Plan
LPAH	low molecular weight polycyclic aromatic hydrocarbon
m^2	square meter
MET	Modified Elutriate Test
mg/kg	milligram per kilogram
MINI	Marine Industries Northwest, Inc.
MLLW	mean lower low water
µg/kg	microgram per kilogram
µg/L	microgram per liter
µm	micron
MWAC	Middle Waterway Action Committee
NPDES	National Pollutant Discharge Elimination System
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
Pioneer	Pioneer Industries, Inc.
PRD/RD	Pre-Remedial Design and Remedial Design
PSEP	Puget Sound Estuary Program
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
ROD	Record of Decision
SBLT	Sequential Batch Leaching Test
SAP	Sampling and Analysis Plan
SDI	Swartz Dominance Index
SOW	Statement of Work
SPT	Standard Penetration Test
SQO	Sediment Quality Objective
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBT	tributyltin
TCLT	Thin-Layer Column Leaching Test
Tech Memo	Technical Memorandum
TOC	total organic carbon
VOC	volatile organic compound

1. INTRODUCTION

1.1 BACKGROUND

The Middle Waterway is located in Commencement Bay and is bounded by the Thea Foss Waterway to the southwest and the St. Paul Waterway to the northeast (Figure 1). The waterway is approximately 3,500 feet long and 300 feet wide. The top of the waterway bank line shown on all figures is generally represented by the +15-foot mean lower low water (MLLW).

This Round 1B Technical Memorandum (Tech Memo) was prepared as required by Section II.B.1.c and Section II.B.2.f of the Statement of Work (SOW), Appendix I to the Administrative Order on Consent (AOC) (United States Environmental Protection Agency [EPA] Docket No. 10-97-0096/Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]) for the Pre-Remedial Design and Remedial Design (PRD/RD) Study of the Middle Waterway Problem Area of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site. The Round 1B Tech Memo is a pre-design document identified in the Revised Final Pre-Remedial Design and Remedial Design Work Plan dated February 23, 1998 (Foster Wheeler Environmental Corporation [Foster Wheeler Environmental] 1998a).

This Tech Memo is submitted on behalf of the Middle Waterway Action Committee (MWAC), currently consisting of Foss Maritime Company (Foss Maritime), Marine Industries Northwest, Inc. (MINI), and Pioneer Industries, Inc. (Pioneer).

1.2 PURPOSE AND SCOPE OF DOCUMENT

This Tech Memo has been designed to identify and provide a basis for additional data collection needs, identify sample locations, numbers, and other details of Round 1B sampling and analysis activities, and reference applicable sampling and analytical methods in the EPA-approved Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HSP) (SAP; Foster Wheeler Environmental, 1998b). This Tech Memo includes a preliminary discussion of the results of Round 1A sampling, including bioassay results, sediment chemistry, and contaminant mobility tests. It also provides an estimate of the volume of sediment which may require active remediation. In addition, it identifies data gaps to be filled in order to accomplish the objectives of the AOC and SOW, proposes Round 1B sampling details (number and location) to fill such gaps, and provides additional information, where necessary, in an addendum SAP and QAPP. It is important to note that a large number of samples have been collected and analyzed in the Middle

Waterway, historically, recently by other parties (e.g., City of Tacoma and Simpson Tacoma Kraft Corporation), and during Round 1A (Figure 2; Foster Wheeler Environmental 1998a).

SOW Objectives—Key Elements

- Spatial resolution of chemical contaminant distribution
- Physical characterization of the waterway
- Assessment of sediment toxicity with respect to potential biological effects
- Assessment of the potential for natural recovery of sediments
- Assessment of habitat distribution and resource use
- Assessment of sediment contaminant mobility
- Assessment of the potential for sediment recontamination
- Characterization of capping materials and confined disposal site(s)
- Assessment of water quality impacts during dredging
- Evaluation of habitat mitigation requirements, if necessary
- Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
- Evaluation of current and planned property uses

Key elements of the SOW objectives have been considered during the development of the Tech Memo to ensure that the data required to meet these objectives are available. Consequently, the overall goals of the sampling activities presented in this Tech Memo are to: (1) fill data gaps from Round 1A sampling activities; (2) develop sufficient information to support and complete a remedial design for the project site; and (3) develop technical specifications, procurement requirements, and other documentation necessary to prepare for implementing the remedial action. These overall objectives also include seeking to achieve an expedited, practical, and cost-effective cleanup of the Middle Waterway that is protective of human health and the environment. Additionally, the potential opportunity for combined disposal with sediments from other CB/NT problem sediments will be pursued.

The evaluation and assessment of both Round 1A and Round 1B data to meet the SOW objectives will be presented in the Pre-Design Data Evaluation Report (Data Evaluation Report), the Evaluation of Remedial Options, and the Recommended Remediation Plan. To assist in the preparation of these reports, this Tech Memo divides the waterway into three areas: Area A (working waterway area), Area B (central tideflats), and Area C (head of the waterway). These areas are shown on Figures 3, 14, 16, and 17.

1.3 ORGANIZATION OF THIS MEMORANDUM

The remainder of this Tech Memo is organized into the following sections:

Section 2. Round 1A Data Results
Section 3. Estimate of the Volume that May Require Active Remediation
Section 4. Data Evaluation, Identification of Data Gaps, and Proposed Round 1B Activities
Section 5. Assessment of the Potential for the Natural Recovery of Sediments
Section 6. Methods for Collecting Additional Data
Section 7. References

Tables and figures, which are numbered sequentially according to their appearance in the text, are grouped after the text. Four appendices are also provided that include core logs (Appendix A); bank sampling summary forms (Appendix B); specific response to EPA comments (Appendix C); and SAP/QAPP Addendum (Appendix D).

2. ROUND 1A DATA RESULTS

Round 1A field sampling for the Middle Waterway project was conducted in May and June of 1998, in accordance with the EPA-approved SAP (Foster Wheeler Environmental 1998b). The Revised Final Round 1A Data Report (Foster Wheeler Environmental and Anchor Environmental 1999) was submitted to EPA on August 23, 1999. The Round 1A Data Report presents the results of the Round 1A activities, including:

- Description of field activities
- Deviations from the approved Work Plan, SAP, QAPP, or HSP
- Tabulated chemical, physical, and biological data with comparison to regulatory criteria
- Sample identification matrix
- Sample location and sample identification information
- Data validation reports
- Field logs
- Chain of custody forms
- Electronic data, submitted in accordance with EPA instructions for formatting digital data (EPA 1993a)

The Revised Final Round 1A Data Report (Foster Wheeler Environmental and Anchor Environmental 1999) should be consulted for a full presentation of Round 1A data. To support the data evaluation and rationale for Round 1B activities, the following tables and figures, reproduced from the Revised Final Data Report, include:

- Figure 3 - Round 1A and Selected Historical Sample Locations
- Figure 4 - Round 1A Surface Samples and Exceedence Factors
- Figure 5 - Round 1A Subsurface Samples and Exceedence Factors
- Figure 6 - Round 1A Bank Samples and Exceedence Factors
- Figures 7 through 13 - Geologic Cross Sections
- Table 1 - SQO and Target Analyte List
- Table 2 - Round 1A Surface Sediment Exceedences
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- Table 4 - Round 1A Bank Sediment Exceedences
- Table 5 - Tributyltin Results

- Table 6 - Conventional and Physical Test Results
- Table 7 - Sediment Standards Biological Criteria
- Table 8 - Comparison of Bioassay/Benthic Results and Sediment Biological Effects Interpretive Criteria

3. ESTIMATE OF THE VOLUME THAT MAY REQUIRE ACTIVE REMEDIATION

This section presents an estimate of sediments that may require active remediation. The objective of providing this estimate is based on the preliminary remediation concept presented in Figure 14, and to facilitate combined disposal with other CB/NT sediments. This preliminary remediation concept and estimate of dredge volumes is based on selected historical and Round 1A data and does not predetermine what active remediation will be selected by EPA. After MWAC has collected and evaluated Round 1A and Round 1B data together (Data Evaluation Report), evaluated appropriate remedial options (Evaluation of Remedial Options Report), and recommended to EPA a remediation plan (Recommended Remediation Plan), a more definitive dredge volume requiring disposal will be available. Specifically, the Data Evaluation Report will provide, based on Round 1A and Round 1B data, an estimate of the volume and area of sediments that will require active remediation and the areas of sediments which may naturally recover or do not require further action. All remedial options evaluated will address the following:

- Proposed natural recovery areas,
- Areas proposed for active sediment remediation,
- Proposed disposal sites,
- General plans for dredging,
- General plans for monitoring during and after remediation, and
- An estimated schedule of performance for all activities proposed.

Estimated volumes assume active remediation will include dredging for specific areas of the Waterway. These estimated dredge volumes account for sideslope (bank) sediments, overdredge depths, and other key issues that can affect volumes removed; nonetheless, this range of volumes should be considered preliminary pending a full evaluation of Round 1A and Round 1B results. The range of sediments that may require removal is estimated at this time to be between 60,000 cubic yards and 85,000 cubic yards, with 75,000 cubic yards being the most likely volume (in situ volume).

4. DATA EVALUATION, IDENTIFICATION OF DATA GAPS, AND PROPOSED ROUND 1B ACTIVITIES

This section evaluates Round 1A data (with consideration of historical data where appropriate) necessary to identify data gaps that would be filled through proposed Round 1B activities. Historical data are discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a). Historical data were used to identify Round 1A sample stations although it was recognized that much of this data was likely not representative of current conditions. Consequently, only the more recent data (generally less than 5 years) were considered during the evaluation of Round 1A data, identification of data gaps, and design of Round 1B activities. Round 1A data are the primary basis for the rationale behind the proposed Round 1B activities.

Key elements of the SOW objectives have been considered as part of this evaluation to ensure that the data required to meet these objectives are available for preparation of the Pre-Design Data Evaluation Report, the Evaluation of Remedial Options, and the Recommended Remediation Plan. To ensure that the applicable SOW objectives will be met by the combination of existing data and proposed Round 1B sampling, a checklist of the key elements of the SOW is provided with the systematic area-by-area evaluation of the Middle Waterway. The geotechnical engineering evaluation is provided in Section 4.12.

To assist in the interpretation of Round 1A results, Figure 15 shows the distribution of SQO exceedences for mercury, LPAHs, HPAHs, and biological testing results for surface (0 to 10 cm) and waterway bank composite samples. Figure 16 and Table 9 present the proposed Round 1B sample station locations and proposed analyses.

4.1 AREA NEAR MW025 AND BANK SEGMENTS B-12, B-13, AND B-14 (AREA A)

As discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a), voluntary source control actions for arsenic, copper, and zinc were performed within waterway bank segment B-13 in 1994. Consistent with this source control action, Round 1A chemical results indicate that bank segment composite (B-13) SQO exceedences are limited to mercury and copper (EF 3.9 and 2.8, respectively). Adjacent bank segments (B-14 and B-12) SQO exceedences are limited to mercury (EF 1.3 and 2.2, respectively). Adjacent surface sediment sample location MW025 has one SQO exceedence (mercury, EF 10). Biological testing performed at this location indicates that there is a minor adverse effect associated with this mercury SQO exceedence. The MW025 0.4 to 5.0-foot interval (below

mudline) also only had a mercury SQO exceedence (EF 2.0). No other chemicals exceeded their SQOs at MW025.

Other nearby Round 1A sample locations that will assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination include Round 1A sample stations MW023, MW020, MW022, MW026, and MW028. None of these nearby sample locations, except MW022, had SQO exceedences of mercury or copper. MW022 had SQO exceedences of mercury (EF 3.7) and copper (EF 1.6); however, biological testing confirmed no adverse effects associated with these chemical concentrations. MW026 had arsenic and zinc concentrations at or close to the SQO (EF 1.2 and 1.0) in the surface sediments though no SQO exceedences of any chemicals were found at depth. Similarly, MW028 had fluorene at the SQO (EF 1.0) and no subsurface SQO exceedences. No recent and applicable historical data (historical data are discussed in the Work Plan) are available in this area to assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination.

Based on this evaluation, the following data gaps have been identified:

1. The potential for copper and mercury in bank segment B-13 to recontaminate waterway sediments or adjacent bank sediments;
2. The linear extent of copper and mercury SQO exceedences within bank segment B-12 and B-14; and
3. The horizontal and vertical spatial resolution of mercury in the vicinity of MW025.

SOW Objectives—Key Elements	
☒	Spatial resolution of chemical contaminant distribution
☒	Physical characterization of the waterway
☒	Assessment of sediment toxicity with respect to potential biological effects
☐	Assessment of the potential for natural recovery of sediments
☒	Assessment of habitat distribution and resource use
☐	*Assessment of sediment contaminant mobility*
☒	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☐	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☐	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

Proposed Round 1B sampling activities necessary to fill these data gaps in this area include:

- Four discrete bank sediment samples within bank segments B-12, B-13, and B-14 (Figure 16). Three of these stations (MW101, MW102, and MW103) are located adjacent to MW025 at the toe of the riprap to assess data gaps 1 and 2. The sample located on the margin between B-14 and B-13 (MW104) is designed to address data gaps 1 and 2. MW101, MW102, and MW103 will be analyzed for copper, mercury, grain size, and percent moisture. MW104 will be analyzed for metals, grain size, and percent moisture. No discrete bank samples will be archived.

- Four co-located surface samples and subsurface cores (MW105, MW106, MW107, and MW108) will be collected around MW025 (Figure 16). These sample locations were chosen to address data gaps 1 and 3. Each core will be advanced to a maximum depth of 8 feet below mudline. The maximum depth is defined as 8 feet because no SQO exceedences have been observed below 5 feet in this area. All four surface sediment samples will be submitted for the analysis of mercury, copper, grain size, and percent moisture because these chemicals are the only concern in adjacent bank and surface sediment samples. The upper interval of each of the four cores will be submitted for mercury, copper, grain size, and percent moisture analysis. All other intervals collected will be archived for the possible future analysis of mercury, copper, grain size, and percent moisture. Subsurface sediment analyses will be limited to these parameters because no other chemicals have been detected above their SQOs in this or other adjacent cores. Archived samples will be submitted for the analysis of mercury (or copper), grain size, and percent moisture if the overlying interval exceeds the SQO.

- Two additional surface sediment samples (MW109 and MW110) will be collected beyond the co-located surface and subsurface sample locations discussed above (Figure 16). MW109 will be analyzed for metals, grain size, and percent moisture. MW110 will be archived and will only be submitted for the analysis of mercury (or copper), grain size, and percent moisture if the extent of surface mercury or copper SQO exceedences is not defined adequately to fill data gap 1.

No additional information for this area is included in the addendum SAP and QAPP.

4.2 AREA NEAR MARINE RAILWAY (AREA A)

The marine railway area includes the area near MW031 and bank segments B-10a, B-10b, B-11a, and B-11b. Round 1A results indicate multiple SQO analytes with concentrations greater than their SQOs in the vicinity of the marine railways. Specifically, bank segments have the following SQO exceedences. Bank Segment B-11b has mercury concentrations close to the SQO (EF 1.1); B-11a has mercury and N-nitrosodiphenylamine SQO exceedences of 7.1 and 1.3, respectively; B-10a has SQO exceedences of metals (arsenic, copper, lead, mercury, and zinc), PAHs, and benzoic acid (EF 1.1); and B-10b has SQO exceedences of metals (arsenic, copper, lead, mercury, silver, and zinc), PAHs and pentachlorophenol (EF 1.9). Surface sediments at MW029 and MW035 have one SQO exceedence each of mercury (EF 2.0 and 1.9, respectively). MW035 also has an isolated exceedence in the second interval (1.5 to 8.0 feet below mudline) of diethylphthalate; it was not detected in either the surface sample or top interval at this location. The surface sediments at MW032 have SQO exceedences of metals (arsenic, copper, mercury, and zinc)

and benzoic acid (EF 2.0). The surface sediment at MW031 has exceedences of mercury (EF 1.6), PAHs, and 4,4-DDE (EF 3.4). The subsurface sediments at MW031 have similar chemical exceedences as the surface sediments to 4 feet below the mudline and has 2,4-dimethylphenol at the SQO (EF 1.2) in the 4.0 to 5.6 feet below mudline interval.

Other nearby Round 1A sample locations that will assist in the spatial resolution of chemical contaminant distribution include Round 1A sample stations MW028, MW030, and MW034. MW034 has SQO exceedences of mercury and phenol (EF 1.3 and 1.5, respectively); however, there are no SQO exceedences in the subsurface sediments at this location. Similarly, MW028 has fluorene at the SQO (1.0) and no subsurface SQO exceedences. MW030 has a single SQO exceedence in the surface sediments (mercury, EF 3.4) but has more significant subsurface exceedences (greater EFs) than were observed at the marine railways. Furthermore, the depths of exceedences at MW027 and MW030 are greater than the depths of exceedences at MW026 and MW029, which implies that current depositions of sediments with SQO exceedences are not contiguous across the waterway. Sixteen sample locations had pore water collected for TBT analysis. No filtered samples were detected at 0.05 µg/L. The highest detected unfiltered sample was from MW032 (0.40 µg/L). No pore water samples were identified with concentrations of TBT that equal or exceed 0.7 µg/L TBT (ion). No recent and applicable historical data are available in this area to assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination.

In 1996, to support the geotechnical evaluations associated with the construction of a new warehouse, MINI advanced two dutch cone penetrometers on the upland portion of their facility, just south of the marine railway area. The records from these geotechnical probes define the local geotechnical conditions and provide sufficient information to support an evaluation and recommendation of an appropriate remedy. This information is provided in Appendix A.

Based on this evaluation, the following data gaps have been identified:

1. The potential for metals in bank segment B-10a and B-11a to recontaminate waterway sediments;
2. The linear extent of metals, PAH, and pesticide SQO exceedences within bank segment B-10b;
3. The horizontal and vertical spatial resolution of metals and semivolatile organic compounds (SVOCs) in the vicinity of the drydock; and
4. The physical layout of the construction of the marine railways.

Proposed Round 1B sampling activities necessary to fill these data gaps in this area include:

- Two co-located surface samples and subsurface cores will be collected around MW031 (Figure 16). These sample locations were chosen to address data gaps 1 and 3. One core will be located between MW031 and MW028 (MW111) to provide information regarding the vertical and horizontal extent of metals, PAH, and other contaminant exceedences north of MW031. The surface sample located at this location will provide information regarding the potential for recontamination from the bank segment B-11. Another co-located surface sample and core (MW112) will be located under the north end of the drydock (which will be temporarily relocated to facilitate sampling). This core will provide information regarding the vertical and horizontal extent of exceedences toward the center of the waterway. Each of the cores will be advanced to a maximum depth of 10 feet below mudline. The maximum depth is defined as 10 feet because no SQO exceedences have been observed below 8 feet in this area. All surface sediment samples and the upper interval of each of the cores will be submitted for analysis of all the SQO constituents except the volatile organic compounds (VOCs). VOCs were not detected during Round 1A in any sample in the Middle Waterway. All other intervals collected will be archived for the possible future analysis of SQO analytes (except VOCs). Archived samples will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.

SOW Objectives— Key Elements

- ☒ Spatial resolution of chemical contaminant distribution
- ☒ Physical characterization of the waterway
- ☒ Assessment of sediment toxicity with respect to potential biological effects
- ☐ Assessment of the potential for natural recovery of sediments
- ☒ Assessment of habitat distribution and resource use
- ☐ Assessment of sediment contaminant mobility
- ☒ Assessment of the potential for sediment recontamination
- ☐ Characterization of capping materials and confined disposal site(s)
- ☐ Assessment of water quality impacts during dredging
- ☐ Evaluation of habitat mitigation requirements, if necessary
- ☐ Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
- ☐ Evaluation of current and planned property uses

- Two additional subsurface cores will be collected in the area of the drydock. One will be located under the south end of the drydock (MW113) and one will be located between the drydock and MW034 (MW114) (Figure 16). These cores will provide information regarding the vertical and horizontal extent of the exceedences near the center of the waterway in this area and will be used to fill data gap 3. The cores will be advanced to a maximum depth of 10 feet below the mudline. The maximum depth is defined as 10 feet because no SQO exceedences have been observed below 8 feet in this area. No surface sample will be collected because these areas are anticipated to be included in an active remediation area (Figure 14). The top interval of each core will be submitted for analysis of all the SQO constituents except VOCs. VOCs were not detected in any Round 1A

samples. All other intervals collected will be archived for the possible future analysis of SQO analytes (except VOCs). Archived samples will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.

- One co-located surface sample and subsurface core (MW137) will be collected between MW035 and MW037 to address data gap 3. The surface sample and top interval of this core will be submitted for analysis of all the SQO constituents except VOCs. All other intervals collected will be archived for the possible future analysis of SQO analytes (except VOCs). Archived samples will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.
- Two surface sediment samples (MW115 and MW117 will be collected under the pier along bank segment B-10b to determine the lineal extent of metal, PAH, and pesticide exceedences in this area (data gap 2). These samples will be analyzed for the SQO analytes (except VOCs).
- Two subsurface cores will be collected in the shipway to determine the vertical extent of contamination in this area. One core will be located on the east side of the shipway adjacent to the pier (MW116) and one will be located on the west side of the shipway near the wooden bulkhead (MW155) to address data gaps 2 and 3. These cores will be advanced to a depth of approximately 10 feet. The upper intervals will be analyzed for the SQO analytes (except VOCs). The remaining intervals will be archived for possible future analysis of SQO analytes (except VOCs). Archived samples will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.
- A physical survey of the marine railway, necessary to support the design of a remedy, is also proposed for Round 1B. No chemical testing is anticipated for this area. A test pit will be dug within the marine railway with a small excavator (Bobcat or similar) to a depth of approximately 3 feet to allow inspection of the foundation of the concrete block wall and to allow visual confirmation of the anticipated configuration of the marine railway structure. The depth of penetration of the concrete block wall and foundation characteristics will be examined and documented to provide information regarding the stability of the wall. The anticipated configuration of the marine railway is shown in Appendix D. The size and layout of the piles, pile caps, stringers, and ties will be confirmed and the lateral spacing of the pile caps will be determined. Probes (e.g., steel rods or PVC poles) will be used to probe other portions of the marine railway to confirm similar construction dimensions of the structure. The probes will be advanced on 3 transects spaced approximately 6 feet apart and with approximately 6-inch spacing on each transect and a penetration of approximately 2 feet. Information gathered during the probing (e.g., relative resistance, contact with timber, etc.) will be recorded.

Additional information for this area is provided in the SAP and QAPP Addendum (Appendix D).

4.3 AREA NEAR MW055 AND BANK SEGMENT B-10C (AREA A)

As discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a), three historic outfalls and one seep were identified within bank segment B-10c. Outfalls, seeps, and permitted discharges to the Middle Waterway have been clearly identified and discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a). These existing data were evaluated against conservative source screening levels (see Table 5 of the Work Plan). This evaluation indicated that although water quality criteria are exceeded, these potential significant sources do not exceed sediment protection levels. Consequently, Round 1B activities focus on an evaluation of bank sediment chemistry as the major indicator of the potential for recontamination. In 1996, MINI constructed a stormwater collection, treatment, and on-site infiltration system effectively controlling these historic potential sources. The stormwater management system is operated in compliance with National Pollutant Discharge Elimination System (NPDES) Permit No. WA-004044-4. In addition, to support the construction of the new warehouse, MINI advanced geotechnical borings on the upland portion of the site in 1996, adjacent to bank segment B-10c. This information is provided in Appendix A.

Round 1A chemical results indicate that bank segment composite (B-10c) has SQO exceedences of arsenic, copper, lead, mercury, and zinc (EF 2.3, 4.3, 4.0, 49.5, and 2.8, respectively) and also has concentrations of PAHs, phenols, pesticides, and PCBs at or near the SQO (maximum EF 1.4). Adjacent bank segment B-10b has similar exceedences of metals and PAHs. Bank segment B-9 had SQO exceedences limited to mercury and PAHs (Figure 6). Adjacent surface sediment sample location MW055 is limited to SQO exceedences of mercury (EF 4.9) and copper (EF 1.0). No other chemicals exceeded their SQOs at MW055. The only other Round 1A sample locations that could assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination include Round 1A sample station MW040 where both surface and subsurface samples were collected. This station is located on a sandy shoal outside the scow shed. No SQO exceedences were found in the surface sample and biological testing confirmed no adverse effects. In the top subsurface interval, a mercury SQO exceedence was observed (EF 2.0). No other chemicals exceeded their SQOs in this or deeper intervals.

No other recent and applicable historical data (historical data are discussed in the Work Plan) are available in this area to assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination.

Based on this evaluation, the following data gaps have been identified:

1. Determination of the linear extent of mercury exceedences within bank segment B-10c to support a source removal activity;
2. The potential for SQO metals, PAHs, pesticides, and PCBs in bank segments B-9 and B-10c to recontaminate waterway sediments or adjacent bank segments;
3. The horizontal and vertical spatial resolution of metals, PAHs, pesticides, and PCBs in the vicinity of the scow shed.

SOW Objectives—Key Elements	
☒	Spatial resolution of chemical contaminant distribution
☒	Physical characterization of the waterway
☒	Assessment of sediment toxicity with respect to potential biological effects
☐	Assessment of the potential for natural recovery of sediments
☒	Assessment of habitat distribution and resource use
☐	Assessment of sediment contaminant mobility
☒	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☐	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☐	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

Proposed Round 1B sampling activities necessary to fill these data gaps in this area include:

- Eight discrete bank sediment samples within bank segments B-10c and B-9 will be collected (Figure 16). These eight stations are located adjacent to the scow shed, MW055, bank segment B-9, and the southern portion of B-10c (MW123 through MW125) to assess data gaps 1 and 2 (MW118 through MW125). These eight samples will be analyzed for SQO metals' grain size and percent moisture. Sediment for analyses of PAHs and pesticide/PCBs will also be collected at each location and archived. Analyses for SQO metals at these locations will allow an assessment of data gap 2. If the discrete samples show SQO exceedences for metals, then no additional analyses of PAHs or pesticide/PCBs will be conducted, as these sediments will likely require active remediation. If a trend is observed or if samples without SQO metal exceedences are found, then PAH, pesticide, and PCB analyses will be conducted to determine if PAHs, pesticides, or PCBs are located beyond the limits of metals SQO exceedences or if they are co-located with the metals.
- Two co-located surface samples and subsurface cores (MW126 and MW127) will be collected within the scow shed (Figure 16). In addition, one surface sample will also be collected near the entrance to the scow shed (MW128). These sample locations are positioned to address data gaps 1, 2, and 3. The cores will be advanced to a maximum depth of 8 feet below mudline. The maximum depth is defined as 8 feet because this area was likely created by dredging and it is anticipated that native material will be encountered at a relatively shallow depth below mudline. In addition, results from the closest Round 1A core location (MW040) shows that SQO exceedences are limited to

mercury in the top interval and no SQO exceedences are observed below 3.5 feet in this area. All three surface sediment samples and the upper intervals from the cores will be submitted for the analysis of PAHs, SQO metals, grain size, and percent moisture because these chemicals are the most elevated in adjacent bank and surface sediment samples. Pesticides and PCBs will also be analyzed in the surface sample at MW127. All other intervals collected will be archived for the potential future analysis of metals, PAHs, grain size, and percent moisture. The archived samples will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.

- One co-located surface sample and subsurface core (MW153) will be collected at the southern end of bank segment 10c and north of the abandoned barges. The surface samples will be submitted for metals, SVOCs, PCBs, pesticides, grain size, and percent moisture. The core intervals will be archived for possible future analysis of metals, SVOCs, PCBs, pesticides, and percent moisture. The samples will only be analyzed if the biological tests performed at this location (Section 4.10) have an SQO failure (minor adverse effects).

No addendum to the SAP or QAPP is necessary for this area. As discussed above, recent geotechnical data adjacent to bank segment B-10c are available (see Appendix A). Site-specific geotechnical data requirements are discussed in Section 4.12.

4.4 AREA NEAR BANK SEGMENT B-9 (AREA B)

As discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a), two historic outfalls and one seep were identified within bank segment B-9. Outfalls, seeps, and permitted discharges to the Middle Waterway have been clearly identified and discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a). These existing data were evaluated against conservative source screening levels (see Table 5 of the Work Plan). This evaluation indicated that although water quality criteria are exceeded, these potential significant sources do not exceed sediment protection levels. Consequently, Round 1B activities focus on an evaluation of bank sediment chemistry as the major indicator of the potential for recontamination. The only available data (from the seep) indicated potential exceedences of copper and zinc. This seep was identified as a potentially significant source in the Work Plan. In addition, two historical sediment samples (MWCTB and MWCTO) located in the vicinity of the two outfalls had concentrations of mercury, zinc, and several PAHs exceeding SQOs. Historical sediment data (historical data are discussed in the Work Plan) are available from HC-5 in this area to assist in the spatial resolution of chemical contaminant distributions and the assessment of the potential for recontamination. SQO exceedences were found for mercury and two PAHs (pyrene and phenanthrene) in the upper interval. This station is also located in the vicinity of the two outfalls. One historical core

(HC-6) was located offshore of the abandoned barges. The 0- to 1-foot interval had a mercury SQO exceedence of 1.2. Both the 1- to 2-foot and 2- to 3-foot intervals did not exhibit SQO exceedences. No recent or historical waterway bank samples are available for this area. Round 1A chemical results indicate that the bank segment composite (B-9) has SQO exceedences limited to mercury (EF 3.4) and eight PAHs (EFs range 1.1 to 3.1). No other metals found in the historical samples (i.e., copper and zinc) were found to exceed the SQOs. Discrete sample B-9 SP was collected farther into the waterway sediments than bank segment B-9 and adjacent to a half-buried drum at the south end of the abandoned barges. Concentrations of mercury (EF 2.7) and five PAHs exceeded the SQO (EFs range 1.1 to 1.7) and lower than those found in B-9. Sample B-9 SP also has copper and zinc concentrations at or close to the SQO (EF 1.0 and 1.1, respectively). Adjacent bank segment B-10c had similar exceedences of metals and PAHs. Bank segment B-8 did not have SQO exceedences of metals or PAHs.

The only other Round 1A sample locations that could assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination include Round 1A sample locations MW044 and MW047 where surface samples were collected. These surface sediment sample locations are limited to SQO exceedences of mercury (EF 4.4 and 2.9, respectively). Except for 4-methylphenol (found at the SQO at MW047) no other chemicals exceeded their SQOs at these locations.

SOW Objectives—Key Elements	
☒	Spatial resolution of chemical contaminant distribution
☒	Physical characterization of the waterway
☒	Assessment of sediment toxicity with respect to potential biological effects
☐	Assessment of the potential for natural recovery of sediments
☒	Assessment of habitat distribution and resource use
☐	Assessment of sediment contaminant mobility
☒	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☐	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☐	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

Based on this evaluation, the following data gap has been identified:

1. The potential for mercury and PAHs in bank segment B-9 to recontaminate waterway sediments.

Proposed Round 1B sampling activities necessary to fill this data gap in this area include:

- Three discrete bank soil samples (MW129 through MW131) will be collected within bank segment B-9 (Figure 16). These samples will be collected from the mid- to upper-bank soils to assess if the chemicals are located within the bank soils and to determine if the soils may be acting as an ongoing source with the potential to recontaminate the waterway sediments. No samples will be archived. Each of these samples will be analyzed for mercury, PAHs, grain size, and percent moisture. Because no correlation of SQO exceedences is noted

between chemicals in bank segment B-9 and adjacent surface sediments (MW044 and MW047) (other than mercury), low concentrations of other SQO analytes, and key elements of the SOW objectives are addressed by these analyses, expanding the chemical list to include other analytical groups is not warranted.

No addendum to the SAP or QAPP is necessary for this area.

4.5 AREA NEAR MW050 AND MW051 (AREA C)

Round 1A chemical results indicate that surface sediment sample MW051 has SQO exceedences of PAHs, phthalates, phenols, mercury, and miscellaneous extractable compounds with EFs up to 9.2. The adjacent bank segment (B-8) has an SQO exceedence of only benzyl alcohol (EF 1.4). A discrete supplemental sample collected from a pile of roofing material/debris (MW008 SP) has SQO exceedences of PCBs and pesticides (EFs less than 2.5). The closest surface sediment locations to MW051 with samples collected recently (1997 and 1998) are MW049, MW052, TF-20 and TF-21. MW049 and TF20 do not have any SQO exceedences. MW052 has an SQO exceedence of only n-nitrosodiphenylamine at an EF less than the exceedence at MW051 (3.0 versus 6.8); however, biological testing confirmed no adverse effects associated with these chemical concentrations. TF-21 has SQO exceedences of mercury (EF 1.4) and bis(2-ethylhexyl)phthalate (EF 1.2). The closest subsurface sediment sample location sampled in 1998 is MW050 (0 to 2 feet below mudline), which also has SQO exceedences of PAHs, dibenzofuran, and 2,4-methylphenol but not other phenols, mercury, or other miscellaneous extractables found at MW051 (i.e., the chemicals with SQO exceedences at MW050 are a subset of the chemicals at MW051 and are generally at lower concentrations).

As discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a), historical stations located in this area include MW-1, F, HC-3, MW772, MW774, MW775, IT-1, IT-2, and IT-3. MW-1 had SQO exceedences of PAHs and mercury in the two 1-foot intervals collected from this core. Sample station F was sampled in 1993, 1996, and 1998. Only the 1998 data were considered because they are the most recent. There were no SQO exceedences reported at F. HC-3 was collected in 1992. Pyrene was detected at the SQO in the 0 to 1-foot interval (EF 1.1) and in the 1 to 2-foot interval (EF 1.1). Six sample locations (MW772, MW774, MW775, IT-1, IT-2, and IT-3) were located just offshore of the former Coast Craft property. MW772 collected had SQO exceedences of PAHs, pentachlorophenol, and dibenzofuran. MW774 had SQO exceedences of PAHs and phenol. MW775 had SQO exceedences of PAHs, pentachlorophenol. The three IT samples were only analyzed for pentachlorophenol. It was detected in IT-2 and IT-3 at concentrations below the SQO, and was not detected in the sample from IT-1.

Outfalls, seep, and permitted discharges to the Middle Waterway have been clearly identified and discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a). This existing data was evaluated against conservative source screening levels (see Table 5 of the Work Plan) and this evaluation indicated that although water quality criteria are exceeded, these potential significant sources do not exceed sediment protection levels. Consequently, Round 1B activities focus on an evaluation of bank sediment chemistry as the major indicator of the potential for recontamination. In this area, no seep or outfall data are available. However, information regarding the potential of outfalls to recontaminate may be obtained from the existing data that has been collected. Outfall 775 may be represented by the data from MW049. Outfalls 720, 772 and 773 may be represented by the data from MW051. Outfall 774 may be represented by the data from both MW049 and MW051.

Based on this evaluation, the following data gaps have been identified:

1. The horizontal and vertical spatial resolution of PAHs, phthalates, phenols, mercury, and miscellaneous extractable compounds in the vicinity of MW051 and MW050;

2. The horizontal and vertical spatial resolution of PCBs and pesticides in the vicinity of MW008 SP; and

3. The potential for PCBs or pesticides in the material from supplemental sample MW008 SP to recontaminate waterway sediments or adjacent bank sediments.

Proposed Round 1B sampling activities necessary to fill these data gaps in this area include:

- One surface sediment sample (MW132) will be located off-shore of MW008 SP to address data gaps 1, 2, and 3. This station will delineate the chemical exceedences between MW049 (no SQO exceedences) and MW051 and will provide further delineation of PCB/pesticide contamination that may be associated with MW008 SP. It will be analyzed for SVOCs, PCB/pesticides, mercury, grain size, and percent moisture because these tests will cover all the chemicals that had SQO exceedences.
- Two discrete bank samples (MW133 and MW134) will be collected near MW008SP and analyzed for PCB/pesticide, grain size, and percent moisture. One will be located north of MW008 SP and one south of MW008 SP to address data gap 3.
- Sufficient sediment for possible future dioxin analysis will be collected at stations MW132, MW135, and MW140 and archived, assuming that MWAC and EPA agree on the conditions that will trigger future dioxin analysis (with the agreed upon conditions set forth in EPA's approval of this Tech Memo).

SOW Objectives - Key Elements

- ☒ Spatial resolution of chemical contaminant distribution
- ☒ Physical characterization of the waterway
- ☒ Assessment of sediment toxicity with respect to potential biological effects
- ☐ Assessment of the potential for natural recovery of sediments
- ☒ Assessment of habitat distribution and resource use
- ☐ Assessment of sediment contaminant mobility
- ☒ Assessment of the potential for sediment recontamination
- ☐ Characterization of capping materials and confined disposal site(s)
- ☐ Assessment of water quality impacts during dredging
- ☐ Evaluation of habitat mitigation requirements, if necessary
- ☐ Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
- ☐ Evaluation of the behavior of dredge material to support detailed evaluation of confinement options

- Five co-located surface sediment and subsurface cores (MW135, MW136, MW138, MW139, and MW141) will be located in the vicinity of between MW050 and MW051 to assess data gap 1 (Figure 16). These surface samples will be analyzed for SVOCs, mercury, grain size, and percent moisture. The surface sample from the core located closest to MW008 SP (and the top interval from this core) (MW135) will also be analyzed for PCB/pesticide analysis. The other intervals from MW135 will be archived for possible future analysis of SVOC, PCB/pesticide, mercury, grain size, and percent moisture analysis. Each core will be advanced to a maximum depth of 8 feet below mudline. The maximum depth is defined as 8 feet because the vertical extent of contamination has not been defined in this area and it is not expected that contamination on this native mudflat would extend to depths greater than this. In addition, in the event that contamination extends greater than 8 feet, any likely removal action in this area will include a replacement component and therefore it is not necessary to define the absolute vertical extent. The upper interval of each of the four remaining cores will be submitted for SVOCs, mercury, grain size, and percent moisture analysis. All other intervals collected will be archived for possible future analysis of SVOCs, mercury, grain size, and percent moisture. Subsurface sediment analyses will be limited to SVOCs, mercury, grain size, and percent moisture because no other chemicals have been detected above their SQOs in this or other adjacent cores. All archived samples will only be submitted for analysis if the overlying interval exceeds the SQO and will only be analyzed for the chemical group that exceeded the SQO, grain size, and percent moisture.

If EPA and MWAC agree on the conditions for dioxin analysis and those conditions are triggered, a SAP amendment incorporating the analytical methods and QA/QC procedures included into the EPA-approved Olympic View Resource Area SAP and QAPP will be submitted to EPA.

4.6 AREA NEAR NATURAL RESOURCES RESTORATION SITE (AREA C)

The City of Tacoma collected samples in this area from the upland and banks down to the tideflats at elevation 0 MLLW in 1997 (City of Tacoma 1997). The only samples collected during Round 1A in this area were from sample locations MW053 and MW054. The surface sediment sample collected from TF-20 had no SQO exceedences. The subsurface sediment core (0 to 2 feet below mudline) collected from MW053 also did not have any SQO exceedences. The surface sediment sample collected from MW054 has SQO exceedences of PAHs, mercury (EF 1.4), and 2,4-dimethylphenol (EF 1.9); however, biological testing confirmed no adverse effects associated with these chemical concentrations. The surface sediment sample collected from TF-21 had mercury and bis(2-ethylhexyl)phthalate SQO exceedences (EF 1.4 and 1.2, respectively). TF-23 had SQO exceedences of mercury (EF 3.8), copper (EF 1.3), PCB (EF 1.6), and benzo(g,h,i)perylene (EF 1.0). TF-22 had the greatest number of SQO exceedences of the waterway sediment samples in this area. It had exceedences of 11 PAHs, mercury, and bis(2-ethylhexyl)phthalate in the surface sediments. TF-22 also had exceedences in the subsurface sediments with 8 PAHs and 2 metals (mercury and zinc) exceeding the SQO in the top interval (0.3 to 1.5 feet below mudline) and 16 PAHs, 3 metals, and dibenzofuran exceeding the SQO in the bottom interval (1.5 to 2.7 feet below mudline). EFs in this bottom interval were up to 90 times the SQO. Bank samples collected by the City of Tacoma in this area in 1997 have similar chemicals with SQO exceedences of PAHs, metals, and PCBs with EFs up to 81 times the SQO.

Based on this evaluation, the following data gaps have been identified:

1. The potential for PAHs, metals, and PCBs to recontaminate subsurface waterway sediments;
2. The horizontal and vertical spatial resolution of PAHs, metals, and PCBs in the sediments between the shoreline and MW054; and
3. The horizontal and vertical spatial resolution of PAHs, metals, and PCBs in the sediments between the TF-21 and TF-22.

Proposed Round 1B sampling activities necessary to fill these data gaps in this area include:

- Four subsurface cores are proposed in this area (Figure 16) (MW141, MW142, MW143, and MW144). Three of these cores will have a co-located surface sample (MW141, MW142, and MW144). Subsurface core MW141 is also discussed in Section 4.5. These sample locations were chosen to address data gaps 1 and 2. The cores will be advanced to a maximum depth of 10 feet below mudline to find the vertical extent of contamination and to determine if contamination increases with depth, which may indicate a groundwater transport pathway. The length of the core intervals will be determined based on the stratigraphy observed in each core. The surface sample and top interval at

MW142 will be submitted for analysis of SVOCs, metals, and PCBs. The surface sample and top two intervals at MW144 will be submitted for analysis of SVOCs, metals, and PCBs. Other intervals will be archived for possible future analysis of SVOCs, metals, or PCBs depending on the results of the overlying interval. Archived intervals will only be analyzed for chemical groups that exceeded the SQOs in the overlying interval. At MW143, the three subsurface intervals will be submitted for analysis of SVOCs, metals, and PCBs.

- If the results from these cores indicate that chemical concentrations increase with depth, and the possibility of a groundwater pathway exists, the installation of up to four 2-inch groundwater monitoring wells adjacent to the head of waterway will be discussed with EPA and Ecology (Figure 16).

SOW Objectives—Key Elements	
☒	Spatial resolution of chemical contaminant distribution
☒	Physical characterization of the waterway
☒	Assessment of sediment toxicity with respect to potential biological effects
☐	Assessment of the potential for natural recovery of sediments
☒	Assessment of habitat distribution and resource use
☐	Assessment of sediment contaminant mobility
☒	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☐	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☐	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

An addendum to the SAP/QAPP is provided in Appendix D.

4.7 SIMPSON RESTORATION SITE (AREA C)

Post-construction sampling indicated that the area (see Figure 7 of the Work Plan [Foster Wheeler Environmental 1998a]) was successfully restored as indicated by the absence of exceedences in the surface sediments (Parametrix 1996, 1998). Long-term monitoring results indicate that surface sediment concentrations of mercury and PAHs are remaining generally at the same concentrations, indicating that recontamination of this restoration site is not occurring. This area exhibits no SQO exceedence and no data gaps exist in this area.

4.8 AREAS NEAR BANK SEGMENTS B-3A AND B-3B (AREA B)

This area is part of Simpson's proposed St. Paul Sediment Facility Habitat Plan. If the proposed habitat plan is implemented, the banks will be removed, pulled back, and re-contoured to create dendritic channels and additional intertidal habitat (Figure 16).

As discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a), two historical outfalls (748, OF-6) were identified within bank segment B-3a. No other historical outfall, seep, or bank sediment data are available for bank segments B-3a or B-3b. Outfalls,

seeps, and permitted discharges to the Middle Waterway have been clearly identified and discussed in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a). These existing data were evaluated against conservative source screening levels (see Table 5 of the Work Plan). This evaluation indicated that although water quality criteria are exceeded, these potential significant sources do not exceed sediment protection levels. Consequently, Round 1B activities focus on an evaluation of bank sediment chemistry as the major indicator of the potential for recontamination. Outfall OF-6 was identified as a potentially significant source in the Work Plan. No recent or historical waterway bank samples were available for this area. Round 1A chemical results indicated that bank segment B-3a composite sample has SQO exceedences of 4,4-DDD (EF 1.4), acenaphthene (EF 1.3), mercury (EF 1.5), and PCBs (EF 2.3). No other chemicals were found to exceed the SQOs. Bank segment B-3b composite sample was limited to an SQO exceedence of pentachlorophenol (EF 2.2). No other chemicals were found to exceed the SQOs in this sample. No SQO exceedences were found in adjacent bank segments B-2 or B-4a.

The only other Round 1A sample locations that could assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination include Round 1A sample locations MW039 and MW042 where surface samples were collected. Sample MW039 is located adjacent to bank segment B-3a. Dibenzofuran (EF 2.2) and 12 PAH SQOs were exceeded with EFs ranging from 1.1 to 3.1 (Figure 6) at this station. Biological testing indicated a minor adverse effect associated with this location. Sample MW042, located adjacent to bank segment B-3b was limited to an SQO exceedence of mercury (EF 1.7). No other chemicals exceeded their SQOs at these locations.

Based on this evaluation, the following data gaps have been identified:

1. The potential for pesticides, PCBs, and PAHs in bank segment B-3a to act as an ongoing source with the potential to recontaminate waterway sediments or adjacent bank sediments;
2. The linear extent of pesticide, PCB, and PAH SQO exceedences within bank segments B-3a and B-3b;
3. The potential for pentachlorophenol in bank segment B-3b to act as an ongoing source with the potential to recontaminate waterway sediments or adjacent bank sediments; and
4. The linear extent of pentachlorophenol SQO exceedences within bank segments B-3b and B-3a.

SOW Objectives—Key Elements	
☒	Spatial resolution of chemical contaminant distribution
☒	Physical characterization of the waterway
☒	Assessment of sediment toxicity with respect to potential biological effects
☐	Assessment of the potential for natural recovery of sediments
☒	Assessment of habitat distribution and resource use
☐	Assessment of sediment contaminant mobility
☒	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☐	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☐	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

All proposed samples collected in this area will be archived. If EPA selects the St. Paul Waterway as a disposal site for CB/NT problem area sediments, it is our understanding that the proposed habitat plan would be implemented. If EPA's selection of the St. Paul Waterway is made within the analytical holding times (one year), archived sediments (as discussed below) will not be submitted for analyses.

Proposed Round 1B sampling activities necessary to fill these data gaps in this area include:

- Three discrete bank samples (MW148 through MW150) located within bank segment B-3a (Figure 16). The samples will be collected from the base of the bank, similar to the method used in Round 1A to determine if the banks may be acting as an ongoing source with the potential to recontaminate the waterway sediments. No additional samples will be archived. Each of the three samples will be analyzed for pesticides/PCBs, PAHs, pentachlorophenol, grain size, and percent moisture. Analysis for mercury is not included for these samples because the observed concentrations in the bank composite sample do not indicate that the banks are a potential source of this chemical. PAHs are included to evaluate the potential for recontamination of the waterway sediments, as indicated by the SQO exceedences found at MW039. Pentachlorophenol will be reported in these samples to delineate the linear extent of this chemical from bank segment B-3b.
- Three discrete bank samples (MW145 through MW147) located within bank segment B-3b (Figure 16). The samples will be collected from the base of the bank to determine if the banks may be acting as an ongoing source with the potential to recontaminate the waterway sediments. Each of the three samples will be analyzed for pentachlorophenol, grain size, and percent moisture. Sediment for analyses of PCBs will also be collected at each location and archived. PCBs are included to assist in the delineation of the linear extent of these chemicals from bank segment B-3a. The archived samples will only be submitted for analysis if PCB exceeds the SQO in MW148.
- One co-located surface sample and subsurface core (MW156) will be collected offshore of MW150 to address data gap 1 (Figure 16). The core will be advanced to a maximum depth of 8 feet below the mudline. The surface sample and top interval will be submitted

for analysis of metals, PAHs, PCBs, pesticides, grain size, and percent moisture. Other intervals will be archived for potential future analysis of metals, PAHs, PCBs, pesticides, grain size, and percent moisture depending on the results of the overlying interval. Archived intervals will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.

- A surface sample (MW154) will be collected offshore of MW146 to address data gap 2 (Figure 16). Sediment will be collected and archived for possible future analysis of PCB, pesticides, grain size, and percent moisture. The sample will only be analyzed for the chemical groups that exceeded the SQO in the surface sample from MW146.
- Sufficient sediment will also be collected and archived for possible future dioxin analysis at MW146 and MW154, assuming that MWAC and EPA agree on the conditions that will trigger future dioxin analysis (with the agreed upon conditions set forth in EPA's approval of this Tech Memo).

No addendum to the SAP or QAPP is necessary at this time. If EPA and MWAC agree upon conditions for dioxin analysis and those conditions are triggered, a SAP amendment incorporating the analytical methods and QA/QC procedures included into the EPA-approved Olympic View Resource Area SAP and QAPP will be submitted to EPA.

4.9 AREA NEAR BANK SEGMENT B-1 (AREA A)

Round 1A sampling in this area occurred at sample locations MW024, MW027, MW030, and bank segment B-1. The surface sediment sample collected from MW024 has an SQO exceedence of fluoranthene (EF 1.7), and concentrations of anthracene and pyrene at or close to the SQO (EF 1.0 and 1.1, respectively); however, biological testing confirmed no adverse effects associated with these chemical concentrations. The surface sediment samples collected from MW027 and MW030 each have an SQO exceedence of mercury (EF 1.5 and 3.4, respectively). Subsurface samples were collected at each of these locations and all three locations have SQO exceedences of PAHs with MW027 also having exceedences of metals, pesticides, 2,4-dimethylphenol, and dibenzofuran and MW030 having exceedences of mercury, 2,4-dimethylphenol, and dibenzofuran. Bank segment B-1 did not have any SQO exceedences. The adjacent bank segments (B-2 and B-15) also do not have chemicals detected above the SQO (Figure 6).

Other nearby Round 1A sample locations that will assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination include Round 1A sample stations MW026 and MW029. MW026 has arsenic and zinc concentrations at or close to the SQO (EF 1.2 and 1.0, respectively) in the surface sediments, although no SQO exceedences of any chemicals were found at depth. MW029 has an SQO

exceedence of only mercury (EF 2.0) in the surface sediments but no SQO exceedences at depth. No recent and applicable historical data are available from this area to assist in the spatial resolution of chemical contaminant distribution and the assessment of the potential for recontamination.

The following data gap has been identified:

1. The horizontal and vertical spatial resolution of PAHs, metals, and pesticides in the sediments between MW027 and MW030.

SOW Objectives—Key Elements	
☒	Spatial resolution of chemical contaminant distribution
☒	Physical characterization of the waterway
☒	Assessment of sediment toxicity with respect to potential biological effects
☐	Assessment of the potential for natural recovery of sediments
☒	Assessment of habitat distribution and resource use
☐	Assessment of sediment contaminant mobility
☒	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☐	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☐	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

Proposed Round 1B sampling activities necessary to fill this data gap include:

- Two subsurface cores will be collected between MW027 and MW030 (one at the toe of the slope (MW151) and the other near the centerline of the waterway (MW152) (Figure 16). The cores will be advanced to a maximum depth of 12 feet below mudline to find the vertical extent of contamination. The length of the core intervals will be determined based on the stratigraphy observed in each core. The top two intervals from each location will be submitted for analysis of the SQO analytes, except VOCs, regardless of the results of the biological testing discussed in Section 4.10. Other intervals will be archived for potential future analysis of SQO analytes, except VOCs, depending on the results of the overlying interval. Archived intervals will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.
- One subsurface core (MW157) will be located between MW030, MW112, and MW114. The top interval will be submitted for analysis of metals, PAHs, PCBs, pesticides, grain size, and percent moisture. Other intervals will be archived for potential future analysis of metals, PAHs, PCBs, pesticides, grain size, and percent moisture depending on the results of the overlying interval. Archived intervals will only be analyzed for the chemical groups that exceeded the SQO in the overlying interval.

No addendum to the SAP or QAPP is necessary for this area.

4.10 BIOLOGICAL TESTING AREAS

The evaluation of Round 1A biological testing results, identification of data gaps, and proposed Round 1B biological testing considers the following:

- EPA and MWAC have had extensive discussions regarding the appropriateness of benthic community analyses as the chronic test for Middle Waterway sediments. These discussions have centered on whether appropriate reference areas could be located that are predictive of adverse effects associated with chemical concentrations and are not complicated by the influence of physical factors. As evidenced by the Round 1A results, agreement on the appropriateness of reference locations remains problematic.
- Many tideflat locations have SQO exceedences limited to a small suite of similar chemicals (e.g., mercury) at similar EFs (~2) where the presence of adverse effects is not likely to be confirmed.
- EPA's request that Round 1B biological testing include benthic infaunal analyses.
- Either measure of chronic effects (i.e., juvenile polychaete or benthic infaunal analyses) will support an evaluation of adverse effects and an overall assessment of habitat.

Based on consideration of these issues, the following data gaps and evaluation procedures have been identified:

1. Confirmatory biological test data in selected subtidal and tideflat locations to determine that the limited SQO exceedences are not associated with adverse biological effects.
2. Confirmatory biological test data in selected subtidal and intertidal locations to assist in the evaluation of potential remedial actions (e.g., no action, natural recovery, active remediation).
3. Filling a spatial data gap between station MW044 near the abandoned barges and station MW040 near the scow shed.

Proposed Round 1B sampling activities necessary to fill these data gaps and the procedures used for evaluation of the results in the subtidal and intertidal areas include the following.

4.10.1 Subtidal Areas (Area A)

Proposed Round 1B sampling activities in the subtidal areas include:

- Perform confirmatory biological testing at two locations within the active shipway portion of the waterway where surface sediment SQO exceedences indicate that additional biological testing may confirm that chemical concentrations are not associated with adverse effects. These data will address data gaps 1 and 2. The two locations are

MW034 and MW037. Confirmatory biological testing at locations MW034 and MW037 is proposed because the surface sediments at these locations are limited to a mercury and a phenol exceedence at MW034 and a mercury and N-nitrosodiphenylamine SQO exceedance at MW037. MWAC has been advised by Simpson that it has no current or anticipated future need for additional depth along the east side of the waterway near these stations so by performing biological testing, remedial options such as no action and natural recovery can be evaluated for this area. In addition, the subsurface sediments at these locations did not exhibit any SQO exceedences, except a mercury SQO exceedence (EF 2.2) in the uppermost interval of MW037.

SOW Objectives—Key Elements	
☐	Spatial resolution of chemical contaminant distribution
☒	Physical characterization of the waterway
☒	Assessment of sediment toxicity with respect to potential biological effects
☐	Assessment of the potential for natural recovery of sediments
☒	Assessment of habitat distribution and resource use
☐	Assessment of sediment contaminant mobility
☐	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☐	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☐	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

The biological testing will be conducted in accordance with the EPA-approved Work Plan (Foster Wheeler Environmental 1988a) and procedures agreed to with EPA during Round 1A. Specifically, sufficient sediment will be collected at each station to perform acute (amphipod and larval tests) and chronic bioassays. The chronic bioassay will be the juvenile polychaete (*Neanthes*) 20-day growth test, the same test used in the subtidal areas during Round 1A. The juvenile polychaete bioassay will be performed at these locations because of the active nature of the waterway (i.e., tug and ship propeller wash) and because an appropriate benthic reference area could not be found for the subtidal area during Round 1A.

4.10.2 Central Tideflats (Area B)

In the tideflats, biological testing was performed at seven locations (MW039, MW040, MW043, MW048, MW049, MW052, and MW054) during Round 1A. Stations MW040, MW043, and MW049 had no SQO exceedences, MW052 had a single SQO exceedence of N-nitrosodiphenylamine (EF 3.0), while stations MW039, MW048, and MW054 showed multiple SQO exceedences of PAHs with EFs less than 3.0 (Figure 4). As discussed in the Revised Final Round 1A Data Report (Foster Wheeler Environmental and Anchor Environmental 1999), the biological designations for all these stations, except MW039 and MW049, indicate that these chemical SQO exceedences are not associated with adverse effects (Table 8). MW039 and MW049 exceeded the minor adverse effects criteria.

Based on the results of the Round 1A biological testing and observations of the limited SQO exceedences in many of the central tideflat locations, the following biological testing is proposed for Round 1B.

- Perform confirmatory biological testing at seven locations within the central tideflats area (Area B, Figure 16) where surface sediment SQO exceedences indicate that additional biological testing may confirm that chemical concentrations are not associated with adverse effects. These data will address data gaps 1 and 2. The seven locations include six previously sampled locations (MW041, MW042, MW044, MW045, MW046, and MW047) and one new location (MW153) located just north of the abandoned barges (Figure 16). Confirmatory biological testing at the six previously sampled locations is proposed because SQO exceedences were limited to mercury for all stations except for MW041 (N-nitrosodiphenylamine, EF 2.1) and MW047 (4-methylphenol, EF 1.0). Mercury EFs ranged from 1.4 to 4.4 at these locations, generally within the range where biological testing may confirm that the chemical concentrations are not associated with adverse effects. The seventh location (MW153) has been selected to fill a spatial data gap (data gap 3) between the abandoned barges (MW044) and the scow shed (MW040). Samples for the entire SQO list will be collected and analyzed at this location.

Grain size, TOC, ammonia, and total sulfides will be collected and analyzed at each location. No additional chemical analyses for SQOs will be conducted because the Round 1A data are sufficient to evaluate remedial options if the confirmatory bioassays indicate adverse effects. Performance of confirmatory biological sampling throughout the central tideflat will allow assessment of remedial options such as no action and natural recovery.

The biological testing will be conducted in accordance with the EPA-approved Work Plan (Foster Wheeler Environmental 1988a). Specifically, sufficient sediment will be collected at each station to perform acute (amphipod and larval tests) and chronic tests (juvenile polychaete or benthic infaunal analyses as defined below). Following the EPA-approved Work Plan, acute bioassays will be performed initially at all test locations. Based on the results of the acute bioassays, a determination of whether chronic tests should be conducted will be made.

- If both acute tests show exceedences of the no adverse effects criteria, no chronic test will be performed, because this location will have been identified as requiring active remediation (see Table 22 of the EPA-approved Work Plan).
- If neither of the acute bioassays fails the no adverse criteria, then the default chronic test will be the juvenile polychaete bioassay at stations MW042, MW044, MW045, MW046, and MW047. Based on the Round 1A chemistry results, none of the tideflat stations, except MW041, had SQO exceedences that were set by benthic AETs.

- In the event that one of the acute tests exceeds the no adverse effects criteria at these stations, then the juvenile polychaete bioassay will be the chronic test given the difficulties encountered in Round 1A over the identification, selection, and appropriateness of benthic reference locations that are comparable to Middle Waterway sediments (see Revised Final Round 1A Data Report and the EPA-approved Work Plan (Foster Wheeler Environmental and Anchor Environmental 1999; Foster Wheeler Environmental 1998a).
- Station MW041 had SQO exceedences of mercury (EF 1.6) and N-nitrosodiphenylamine (EF 2.1). N-nitrosodiphenylamine SQO was set by a benthic AET. Therefore, at MW041 and at the new location (MW153), because no chemical data are currently available, benthic infaunal analyses will be the default chronic test. Hylebos reference station MW206 is anticipated as the reference station for both MW041 and MW153; however, the actual reference location for MW153 will be determined by the outcome of field grain size and actual TOC results from this location.

4.11 CONTAMINANT MOBILITY TESTING EVALUATION

As outlined in the EPA-approved SAP (Foster Wheeler Environmental 1998b), a composite was created that is representative of sediments that may require removal from the subtidal area. A description of how the composite was determined to be representative of the potential dredge prism and specific cores that were combined is provided in the Round 1A Data Report. It is important to note that this determination was approved by EPA prior to creating the composite. Small volumes of potential "hotspot" sediments that may require removal from the head of the waterway (Area C), relative to the possible overall dredge volume (see Chapter 3, ESTIMATE OF THE SEDIMENT VOLUME THAT MAY REQUIRE ACTIVE REMEDIATION), are not expected to alter the predictive accuracy of the contaminant mobility testing results.

The Round 1B Tech Memo is designed to meet key elements of the SOW objectives, including an assessment of sediment contaminant mobility. MWAC intends to present the evaluation and assessment of sediment contaminant mobility in the Data Evaluation Report.

Nonetheless, in order to address EPA's concerns, MWAC's evaluation of potential "hotspot" sediments, and the effect that these additional volumes may have on the predictive accuracy of the contaminant mobility testing results, considers the following:

1. The most likely volume of sediments that may require removal from Middle Waterway is 75,000 cubic yards and includes over-dredging of sediments less than the SQO.

2. In the absence of Round 1B data necessary to understand the spatial resolution of sediments that require removal, we have evaluated three "hotspot" volumes (5,000, 10,000, and 15,000 cubic yards). These preliminary volumes are based on Round 1A and historical chemical data.

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☒	Assessment of sediment contaminant mobility
☐	Assessment of the potential for sediment recontamination
☐	Characterization of capping materials and confined disposal site(s)
☒	Assessment of water quality impacts during dredging
☐	Evaluation of habitat mitigation requirements, if necessary
☒	Evaluation of the behavior of dredge material to support detailed evaluation of confinement options
☐	Evaluation of current and planned property uses

3. In the absence of Round 1B data necessary to understand the spatial resolution of sediments that require removal, we have defined potential "hotspot" sediments based on the Round 1A and historical chemical data from the head of the Middle Waterway. Specifically, the representative chemical concentration of the *potential "hotspot" sediments* are based on the average chemical concentration from stations located with the potential "hotspot" area(s).

4. The relatively large volume and similar chemical concentration of other CB/NT sediments that may be co-disposed with Middle Waterway sediments.

As presented in Table 10, the inclusion of potential "hotspot" sediments to the sediments requiring removal, with consideration of combined disposal with other CB/NT sediments, the predictive accuracy of the contaminant mobility test results is not affected. If, however, Round 1B investigations in head (Area C) indicate that the concentration and the volume of sediments that require active remediation is greater than anticipated (not appropriate for nearshore or aquatic disposal), alternatives to removal and disposal with sediments from the working waterway area (Area A) will be evaluated. To support these evaluations, duplicate cores at MW135, MW138, MW139, MW141, MW142, and MW144 will be collected anoxically archived at 4° C for up to one year. If Round 1B data from Area C indicates that dredging and with upland disposal or in-place capping is a reasonable remedial action, archived cores will be extracted in an anoxic environment to create, in consultation with EPA, a composite representative of potential remedial action areas. This composite sediment may be submitted for Sequential Batch Leaching Test (SBLT) and/or tests required for Subtitle D disposal.

4.12 GEOTECHNICAL ENGINEERING EVALUATION

Additional information is necessary to assess the geotechnical engineering properties and hydrogeologic conditions of the waterway as they pertain to remedial design. The Round 1B geotechnical engineering assessment will support the:

- Characterization of subsurface physical conditions at the site;
- Evaluation of the stability of slopes immediately adjacent to proposed dredge cuts;
- Design of retaining structures immediately adjacent to proposed dredge cuts; and
- Evaluation of the potential impacts of cap placement on pier structures.

SOW Objectives—Key Elements	
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☐	Evaluation of current and planned property uses

To support these assessments, a total of 8 geotechnical borings are proposed for Round 1B (Figure 16).

4.12.1 Subsurface Physical Conditions

Section 3 of the Round 1A Data Report summarizes the regional and site-specific geology for the Middle Waterway site. Figure 7 locates existing explorations within the project area. The geology at the project site generally consists of alluvial and marine sediments over older glacially deposited soil. The Puyallup River deposited native sediments over the glacial soils. These sediments are typically loose sand, loose sandy silt, soft sandy silt, or soft silt. The grain size varies due to fluctuations in river flow, river channel locations, and sediment load in the river. Dense glacial soils appear to be over 200 feet below the ground surface elevation. Geotechnical borings completed as part of the slope and bulkhead design (see below) will also better our understanding of the subsurface conditions within the Middle Waterway. Geotechnical borings recently completed within the St. Paul Waterway by the City of Tacoma are also expected to provide important information.

4.12.2 Stability of Slopes

Deep dredge cuts may be required in some locations of the waterway. These cuts could potentially reduce the stability of adjacent slopes. To assess this potential for slope instability, borings will be advanced in the slopes adjacent to areas of dredging. Borings will

be advanced to a depth of at least 20 feet below the proposed dredge cut elevation. Figure 16 shows the location of the proposed borings.

Engineering strength properties will be estimated for the different soil units. Properties will be determined from the Standard Penetration Test (SPT) blowcounts, index testing, and strength tests. Appendix D describes in detail the proposed tests.

The stability of the slopes will be assessed using conventional slope stability models. Strength parameters obtained from the laboratory testing as well as engineering judgement will be used as input into the models. Short-term (i.e., during construction) and long-term stability of the slopes will be assessed. Long-term stability will include a seismic assessment.

Appropriate slope angles will be determined at the completion of the analyses.

4.12.3 Retaining Structure Design

If slopes are required to be steeper than determined reliable, structural means might be required to reinforce the slope or protect existing waterway structures. Such means may include sheet pile walls. Sampling and analysis described previously for slope stability assessment will also be applicable to retaining structure design. Figure 16 shows the locations of the proposed borings and Appendix D describes sampling and analysis techniques.

Conventional retaining structure models will be used to provide preliminary design.

4.12.4 Capping-Induced Impacts to Pier Structures

In situ capping is a potential remedial measure that may be evaluated during design. The placement of fill over soft sediments can induce settlement. Only a fraction of an inch of settlement around piling can induce down-drag on piles. Piles not designed to accept down-drag will settle under the weight of the soil on the pile. This pile settlement can damage the structure supported on the piles.

The geotechnical sampling and analysis program described previously and detailed in Appendix D would also provide data necessary to complete the settlement assessment. Consolidation testing would be completed to estimate consolidation parameters.

Conventional settlement models would be used to estimate settlements. An understanding of the structure and its foundation will be required to assess the potential impact to the structures.

5. ASSESSMENT OF THE POTENTIAL FOR THE NATURAL RECOVERY OF SEDIMENTS

The CB/NT Record of Decision (ROD) (EPA 1989) lists natural recovery as part of the preferred remedial option for the Middle Waterway. Natural recovery is the improvement of sediment quality over time without active remediation of the sediments following source control. Surface sediment chemical concentrations and the potential for adverse effects to biological resources can be reduced through a combination of natural processes and source control activities. Natural recovery was an important remedial component within the nearby Sitcum Waterway Problem Area of the CB/NT Site, and its effectiveness in this case has been verified by subsequent post-construction monitoring. Similar applications of the natural recovery technology are envisioned within the Hylebos Waterway (personal communication, Clay Patmont, Anchor Environmental, LLC., Seattle, WA, December 2, 1998).

SOW Objectives—Key Elements	
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☐	Evaluation of current and planned property uses

The EPA-approved Work Plan (Foster Wheeler Environmental 1998a) states that if MWAC decided to pursue natural recovery as a viable remedial option for certain areas of the Middle Waterway, the Tech Memo will outline the elements of a natural recovery demonstration and any outstanding Round 1B data needs necessary to complete this demonstration.

The remainder of this section presents potential natural recovery areas, outlines elements of the proposed natural recovery evaluation, and identifies outstanding data needs necessary to complete this demonstration. A description of two natural recovery models is also presented.

5.1 POTENTIAL NATURAL RECOVERY AREAS AND ELEMENTS OF THE NATURAL RECOVERY DEMONSTRATION

Potential natural recovery areas (see Figure 17) have been identified based on Round 1A data and on the specific considerations discussed below. The areas may be modified based on data collected during Round 1B. These considerations will be the elements of the natural recovery demonstration, if necessary, presented in the Data Evaluation Report.

Areas where review of available historical data suggests surface chemical concentrations are improving. A summary of existing sediment quality data from previous studies within the Middle Waterway was presented in the EPA-approved Work Plan (Foster Wheeler Environmental 1998a). Limited sediment data within the potential natural recovery areas exist by which long-term trends can be evaluated.

For example, ESTUARY2 located at waterway Station 32 had a mercury EF of 6.1 in 1985 (Johnstone 1985). Round 1A samples within this area (MW045, MW048, MW043, MW042, MW049, MW047, MW051, and MW052) indicate that current mercury EFs in this area range from below 1.0 (MW048, MW043, MW049, MW052) to a maximum of 4.4 (MW044). ESTUARY2 did not include the analysis of other chemicals. Nonetheless, existing mercury data suggest that surface sediment concentrations are improving in this area.

Areas where Round 1A and proposed Round 1B biological testing indicates that the minor adverse effect threshold is not exceeded in more than one test. The results of Round 1A biological testing are presented in the Revised Final Round 1A Data Report (Foster Wheeler Environmental and Anchor Environmental 1999). Section 4 of this Tech Memo outlines proposed Round 1B biological testing. Round 1A sample stations collected within the mouth area (MW022, MW024, and MW025) indicate that sediment concentrations at MW022 and MW024 are not associated with any adverse effects (e.g., does not exceed minor adverse effect threshold) and no action is required (Table 5 of the SOW). MW025 exceeds the minor adverse criteria for the chronic test *Neathnes* only and is a potential natural recovery area (Table 5 of the SOW).

Round 1A tideflat area stations with biological testing results include MW039, MW040, MW043, MW048, MW049, MW052, and MW054. Biological testing confirms that chemical concentrations at these stations do not exceed the minor adverse effects threshold (no action required) with the exception of MW039 and MW049. These locations exceeded the minor adverse threshold for the chronic benthic test and are potential natural recovery areas. No chemicals exceeded their SQO at MW049. Round 1B biological testing is proposed at other sample stations within the tideflat area to evaluate the presence or absence of adverse effects.

In the absence of biological testing, areas where chemical concentrations are generally less than 2 times the SQO. For the purposes of identifying potential natural recovery areas, in conjunction with other natural recovery considerations discussed in this section, sample locations with SQO EFs of 2 or less are considered concentrations that may be reduced through a combination of natural processes and source control activities. The use of a guideline SQO EF, subject to confirmation during the demonstration of natural recovery, has been used at other CB/NT waterways (e.g., Hylebos Waterway) (Hylebos Cleanup

Committee 1998). The demonstration of natural recovery, if necessary, provided in the Data Evaluation Report will consider the use of natural recovery modeling (see below) to predict the reduction of chemical concentrations through time.

Some areas where prior sample results indicate chemical concentrations are at or near the SQO (MW021; EF for mercury is 1.29 and MW018; EF for N-nitrosodiphyenylamine is 1.04) will not require site-specific natural recovery modeling because minor SQO exceedences, in combination with other natural recovery considerations, represent a preponderance of evidence in favor of natural recovery.

Areas where control of significant sources within the waterway are expected to assist recovery. Source control activities that will contribute to natural recovery include:

- Removal of any bank material that is a significant source to the waterway;
- Improved management practices and controls associated with both point discharges and non-point sources; and
- Removal or capping of sediments that have the potential to be resuspended and deposited in other areas of the waterway.

Areas that represent valuable habitat and have the potential for synergistic restoration activities. The EPA-approved Work Plan (Foster Wheeler Environmental 1998a) provides a description of the Middle Waterway aquatic habitat and natural resources. The tideflat and vegetated shallows are identified as "special aquatic sites" (COE et al. 1993; USFWS and NOAA 1996) because they provide feeding and resting habitat for fish, waterfowl, and shorebirds and support a diverse assemblage of marine invertebrates. The Middle Waterway also includes a number of restoration sites (the Salmon Enhancement Project, the Middle Waterway Shore Restoration Project, the Olympic View Restoration Site, and the Middle Waterway Estuarine Natural Resources Restoration). Proposed habitat improvements associated with the St. Paul Sediment Facility are also located within the Middle Waterway. MWAC is committed to maintaining existing valuable habitat and exploring other potential, synergistic habitat restoration activities within the Middle Waterway.

Areas where surface sediment PCB concentrations are between 300 and 450 µg/kg dry weight. Areas that have surface sediment chemical concentrations between 300 and 450 µg/kg dry weight are appropriate for natural recovery.

Areas where the application of thin-layer capping may enhance natural recovery. Thin-layer capping (enhanced natural recovery areas), where a thin-layer (2 to 10 cm) of clean sediment is applied so that natural processes of mixing and ecosystem recovery can take place, will be considered during the demonstration of natural recovery. The effect of this clean sediment on recovery may be modeled using natural recovery models in the same way as natural sedimentation (see discussion on natural recovery modeling). Thin-layer placement was successfully implemented at the West Harbor Operable Unit, Wyckoff/Eagle Harbor Superfund Site., Bainbridge Island, Washington (EPA 1992; Corps 1992).

5.2 ROUND 1B DATA COLLECTION NEEDS TO SUPPORT A DEMONSTRATION OF NATURAL RECOVERY

Round 1A and proposed Round 1B sampling activities have been reviewed to ensure that sufficient information will be available to support a demonstration of natural recovery, if necessary, in the Data Evaluation Report. Additional data collection is necessary to support natural recovery modeling in the central tideflats area. This section discusses key parameters for predicting natural recovery with the use of modeling and describes Round 1B data collection needs.

Key parameters for use in natural recovery modeling, as discussed in the CB/NT Feasibility Study (Tetra Tech 1988), the Washington State Sediment Cleanup Standards User Manual (Ecology 1998), and Officer and Lynch (1989), include:

- Gross sedimentation rate;
- Net sedimentation rate;
- Resuspension rate;
- Sediment porosity and density;
- Initial surface sediment chemical concentration;
- Input sediment chemical concentration;
- Bioturbation rate and depth of the upper mixed sediment layer;
- Chemical and biological degradation rates; and
- Interface concentrate exchange coefficient.

The basis for determining the appropriate value of each of these parameters and any Round 1B data collection requirements necessary to apply a natural recovery model are described below. This discussion was adapted directly from personal communications with Clay Patmont, Anchor Environmental, LLC, Seattle, Washington on several occasions in December 1998.

Gross Sedimentation Rate. The gross sedimentation rate is a measure of the total quantity of material that initially settles onto bottom sediments. Only a portion of the gross sedimentation rate is retained in the bottom sediments (i.e., net sedimentation); some amount of these materials may be resuspended due to currents, waves, propeller wash, or other actions (resuspension rate).

Particulate matter settling rates through the water column are typically derived from local measurements of the mass accumulation of particulate matter in sediment traps. Ecology (Norton 1996) has deployed sediment traps in a number of CB/NT problem areas (Sitcum, Hylebos, and Thea Foss Waterways). Based on these data, the range of gross sedimentation rates expected in the Middle Waterway are available. No site-specific data are necessary.

Net Sedimentation Rate. The net sedimentation rate is the fraction of the gross sedimentation rate that is retained in the bottom sediments. Net sedimentation rates are expected to be minimal in tideflat areas and relatively rapid in bank, underpier and slope areas. Slope and underpier sedimentation rates will be based on data collected in the Sitcum Waterway. No additional site-specific data are required.

Resuspension Rate. The fraction of the gross sedimentation rate that is not incorporated into net sedimentation is equal to the resuspension rate, the result of periodic natural and anthropogenic currents sufficient to resuspend surface sediments back into the water column. Depending on the location (i.e., erosional or depositional area), 0 to 100 percent of the gross sedimentation rate is cast back up into the water column through the resuspension process. For tideflat, slope, and underpier scenarios, net deposition will approach 100 percent of the gross sedimentation rate. The resuspension rate estimates were used to determine the value of the interface concentrate exchange coefficient in the Officer and Lynch (1989) model. No additional site-specific data are required.

Sediment Porosity and Density. Based on the data obtained from detailed sediment core profiles collected in CB/NT problem areas, the average density of dry sediment is approximately 2.6 g/cm^3. The average density of seawater in CB/NT problem areas is approximately 1.03 g/cm^3. These data, along with the measured total solids content of the sampled sediments determined during Round 1A, will be used to calculate sediment porosity and to convert length-based sediment data (e.g., cm/yr) into mass-based units (e.g., gms dry wt/cm^2-yr) for use in the model, if used. No additional site-specific data are required.

Initial Surface Sediment Chemical Concentrations. Surface sediment (i.e., 0 to 10 cm) chemical concentrations within the Middle Waterway will be determined from Round 1A and Round 1B data. Based on evaluation of these data, the natural recovery demonstration, if

necessary, will be limited to appropriate indicator chemicals. No additional site-specific data are required.

For the purpose of the natural recovery demonstration, initial sediment chemical concentrations at a given sampling station will be calculated as the arithmetic average concentration from all available Round 1A and Round 1B surface sediment (0 to 10 cm) data representative of the potential natural recovery area.

Input Sediment Chemical Concentrations. Following completion of remedial actions within the mouth of the Middle Waterway (e.g., dredging of bank and subtidal sediments that have elevated SQO exceedence and are subject to resuspension), the source of accumulating sediments within this area of the waterway will largely be from the transport of clean surface sediments located in Area A through tidal advection, episodic storm or propeller wash. In the Officer and Lynch (1989) model, input sediment concentrations will be applied to all natural recovery stations within the tideflats as a flux input, obtained by multiplying the mass accumulation rate by the input concentration.

Bioturbation Rate and Depth of the Upper Mixed Sediment Layer. By definition in the AOC, the benthic mixed layer consists of the top 10 cm of the bottom sediments. Based on work in CB/NT problem areas, a constant bioturbation rate of 50 cm^2/yr is appropriate for the 10-cm mixed layer depth. Sediment density and porosity characteristics will be used to calculate the effective bioturbation diffusion parameter (g^2/cm^4-yr). Site-specific information regarding bioturbation rates in the tideflat area is required. Cores will be collected and analyzed for a known tracer (e.g., Hg) at discrete intervals; this profile will be compared with historical profiles to estimate the bioturbation rate.

Chemical and Biological Degradation Rates. Even though there is evidence for chemically and biologically mediated degradation of some chemicals (e.g., PAHs), the natural recovery demonstration will conservatively assume no degradation unless the only chemicals that exceed the SQO are amenable to degradation (i.e., no metals are present above the SQO).

Non-Advective Exchange. The non-advective exchange represents processes that contribute to the exchange of contaminants without contributing to the sedimentation rate. Examples include the periodic and/or episodic resuspension and subsequent settling of sediments due to tidal cycles, storm events, and propeller wash. For the purposes of natural recovery modeling, this parameter will be calculated as the product of the resuspension rate and the fraction of resuspended sediments that, due to tidal advection and dispersion processes, are not provided sufficient time to resettle in the region. Representative settling velocities for different sized sediment material (i.e., sand, silt, and clay fractions) will be obtained from the U.S. Army Corps of Engineers STFATE program, or using Stokes relationship for fall

velocity. The stated settling velocities for sand, silt, and clay fractions are expected to be 0.6 cm/sec, 0.3 cm/sec, and 0.06 cm/sec, respectively in the tideflats area. Site-specific data about the sediment fractions will be obtained.

Dispersion caused by bottom layer (landward) transport by the oscillatory motions of the tides contributes to water movement and sediment transport. Based on current meter data available for the mouth of other CB/NT problem areas, the tidal-average recharge velocity of these bottom waters is approximately 3 cm/sec. Although dispersion coefficients have not been measured directly in the Middle Waterway, detailed salinity profiling was recently performed by the City of Tacoma to evaluate long-term dispersion coefficients for the geometrically similar Thea Foss Waterway. The tidal-average dispersion coefficient derived from these determinations—approximately 8 m^2/sec—agrees favorably with other regional dispersion estimates. The longer of the water residence times estimated from an initial advection and/or dispersion analysis was used to calculate conservative (minimizing natural recovery rates) water residence times within the mouth segment (Fischer et al. 1979). Using the data outlined above, the average residence time for a representative particle of sand, silt, and clay can be calculated. Finally, the interface concentrate exchange parameter was estimated as the fraction of sediments suspended and transported out of the entire area multiplied by the resuspension rate. If non-advective processes result in significant off-site transport of sediments, natural recovery may not be an acceptable remedial alternative. No additional data collection is required to make this evaluation.

Outstanding data gaps discussed above that will need to be filled during Round 1B to ensure that the appropriate information is available to make a demonstration of natural recovery includes:

- Information to support an estimate of bioturbation rates in Area B;
- Information to support an estimate of the average density of dry sediment in Area B; and
- Empirical information regarding sedimentation rates in Area B.

The following Round 1B activities will address these outstanding data gaps.

- Advance 2 natural recovery cores in the tideflat area (Figure 16) to a maximum depth of 100 cm (approximately 2 feet);
  - Vertical sectioning of these 2 cores into 3 to 5 cm intervals (total of 10 to 16 intervals); and
  - Submittal of selected intervals for the analysis of total mercury, total solids, and specific gravity.

- Eight stakes will be installed in Area B (Figure 16).

– Record sediment levels approximately once a quarter at a low tide condition over an approximate one-year time frame. Visual observations will be made monthly.

Additional information regarding these activities is provided in Appendix D.

5.3 NATURAL RECOVERY MODELING

Various natural recovery models have been developed to predict changes in surface concentrations of contaminants over time and to assist in selecting areas as sediment recovery zones. Two such models include SEDCAM (Ecology 1991) and the Officer and Lynch (1989) model. Each of these models is described below.

5.3.1 SEDCAM

SEDCAM is a mathematical model developed to predict the surface sediment concentrations for CB/NT problem areas (Tetra Tech 1988). SEDCAM incorporates the effects of sedimentation, biodegradation, and diffusion processes. The model assumes a well-mixed system and allows for the continual input of contaminants with sedimentation.

The concentration at time t is estimated as:

$$C(t) = \frac{v}{(v+kd)} C_p \left[1 - \exp\left(\frac{-(kd+v)t}{d} \right) \right] + C_o \exp\left(\frac{-(kd+v)t}{d} \right)$$

where

C(t) = concentration of a contaminant at time t (mg/kg)
v = rate of deposition (g/cm^2-yr)
d = total accumulation of sediments in the mixed layer (g/cm^2)
k = combined first order rate constant for decay and diffusion processes (yr^{-1})
C_p = concentration of contaminant deposited (mg/kg)
t = natural recovery time period (yr)
C_o = initial concentration in surface sediments (mg/kg)

The total accumulation in the mixed layer is calculated as:

$$d = d' \rho_s (1 - \phi)$$

where

d' = thickness of the mixed layer (cm)
ρ_s = density of particulate material (g/cm^3)
ϕ = porosity of the sediments (cm^3/cm^3)

SEDCAM predicts contaminant concentration changes due to natural recovery resulting from macroscale processes. Among its potential limitations are the assumption of complete mixing of the upper mixed layer and the representation of the upper boundary condition as a concentration term, rather than the more mathematically accurate flux boundary condition (van Genuchten and Parker 1984). For these reasons, a natural recovery demonstration will not be based on merely the SEDCAM model, but instead may include the Officer and Lynch-type formulation including bioturbation, advection, and diffusion processes that more accurately represent the primary natural recovery processes, as described below.

5.3.2 Bioturbation, Advection, and Diffusion Modeling (Officer and Lynch)

Officer and Lynch (1989) is a one-dimensional model which incorporates the burying of contaminated sediments, the mixing of cleaner sediments to the surface by benthic organisms, and the exchanges between the bottom sediments and water column. The model also allows for non-advective concentrate exchange due to periodic and episodic resuspension of bottom sediments and exchanges across the bottom boundary layer. In the Officer and Lynch model, the bioturbation effects are represented by a constant diffusion coefficient applied over the mixed layer interval (below which is a non-diffusive medium).

The Officer and Lynch model is based on the concentrate continuity equations for a system that includes advective and diffusive processes (Officer and Lynch 1982)*. The model applies a radiation-type boundary condition for the sediment-water interface and the bottom of the mixed layer. Using a mass-based coordinate system, the model solution for an instantaneous source of unit strength at z=0 and t=0 is the following (Officer and Lynch 1989):

$$c_1(z,t) = \exp\left(\frac{vz}{2D} - \frac{v^2 t}{4D} - kt\right)\sum_{n=1}^{\infty} Z_n(z)\exp\left(-D\alpha_n^2 t\right)$$

* The general form of the governing equation is :

$$\frac{\delta c}{\delta t} = \frac{\delta}{\delta x}\left(D\frac{\delta c}{\delta x}\right) - v\frac{\delta c}{\delta x} - kc$$

(where c = the concentration, D = the diffusion parameter, v = the burial velocity and k = the reaction rate constant)

where

z = sediment particle accumulation (g/cm^2)

D = diffusion parameter (g^2/cm^4-yr)

V = interface concentrate exchange coefficient (g/cm^2-yr)

α_n are given by solution of the transcendental equation

$$\tan \alpha_n d = \frac{4D\alpha_n(v+V)}{4D^2\alpha_n^2 - v(v+2V)}$$

and

$$Z_n = \frac{2D^2\alpha_n^2(D^2\alpha_n^2 + \frac{v^2}{4})(\cos \alpha_n z + \frac{v+2V}{2D\alpha_n}\sin \alpha_n z)}{d(D^2\alpha_n^2 + \frac{v^2}{4})\left[D^2\alpha_n^2 + \frac{(v+2V)^2}{4}\right] + D(v+V)\left[D^2\alpha_n^2 + \frac{v(v+2V)}{4}\right]}$$

For a distributed source, f(t), at the sediment-water interface, the concentration becomes (Officer and Lynch 1989):

$$C_1(z,t) = \int_{-\infty}^{t} f(t')c_1(z,t-t')dt'$$

where

t = time a given core was taken and analyzed (yr)

This model was successfully applied and verified for atmospheric inputs of ^{137}Cs in Blelham tarn, Lake Michigan, and Long Island Sound (Officer and Lynch 1982); and for mercury concentrations in Bellingham Bay sediments (Officer and Lynch 1989). The Officer and Lynch model was also previously used to predict natural recovery within the nearby Sitcum Waterway Operable Unit of the CB/NT Site.

6. METHODS FOR COLLECTING ADDITIONAL DATA

The sampling and analytical methods that will be used during Round 1B are described in the Round 1A SAP (Foster Wheeler Environmental 1998b). A SAP/QAPP addendum for the sampling and analysis methods not included in the Round 1A SAP and QAPP (Foster Wheeler Environmental, 1998b; 1998c) is provided in Appendix D.

7. REFERENCES

City of Tacoma. 1997. Middle Waterway Estuarine Natural Resources Restoration Project. Site Characterization Report. January 1997.

City of Tacoma. 1996. Middle Waterway Estuarine Natural Resources Restoration Project. Concept Plan and Sampling and Analysis Plan. October 1996.

CEO (Creative Engineering Options). 1996. Geotechnical Engineering Study, Proposed Replacement Warehouse, Marine Industries Facility. Prepared for Marine Industries, Inc. by CEO, Redmond, WA. September 5, 1996.

COE et al. (United States Army Corps of Engineers, United States Environmental Protection Agency, United States Fish and Wildlife Service, and National Oceanographic and Atmospheric Administration). 1993. Commencement Bay Cumulative Impact Study. Volume 1 (Assessment of Impacts) and Volume 2 (Restoration Options).

Corps (U.S. Army Corps of Engineers). 1992. Eagle Harbor, Washington, Thin-Layer Placement of Dredged Material, Feasibility Analysis. Seattle, WA: Seattle District.

DiGiano, F.A., Miller, C.T., and J. Yoon. 1995. Dredging Elutriate Test (DRET) Development. Contract Report D-95-1. Prepared for U.S. Army Corps of Engineers, Washington, D.C. University of North Carolina, Chapel Hill, NC.

Ecology (Washington Department of Ecology). 1998. Washington State Dioxin Source Assessment. Washington State Department of Ecology, Olympia, WA. July 1998.

Ecology. 1993. Various source data provided to MWAC on September 24, 1997.

Ecology. 1991. Sediment Cleanup Standards User Manual, Olympia, WA.

Environmental Partners, Inc. 1995. Coastcraft Property Phase II Rounds 1 and 2 Environmental Site Assessment. Prepared by Environmental Partners, Inc., Bellevue, Washington for Service Steel and Aluminum, Inc. Tacoma, WA.

EPA (U.S. Environmental Protection Agency). 1992. West Harbor Operable Unit, Wyckoff/Eagle Harbor Superfund Site. Record of Decision. Seattle, WA: Region 10.

EPA. 1993. Instruction for Formatting of Digital Data: Sediment (Chemical, Benthic, Bioassay), Water Column, and Shellfish Monitoring Data, Commencement Bay Nearshore/Tideflats Superfund Site. Prepared by EPA, Region 10, Seattle, WA.

Fischer et al. 1979. Mixing in Inland and Coastal Waters. Academic Press.

Foster Wheeler Environmental. 1998a. Revised Final Pre-Remedial Design and Remedial Design Work Plan (dated February 23, 1998). Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee. Bellevue, WA.

Foster Wheeler Environmental. 1998b. Sampling and Analysis Plan. Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee. Bellevue, WA.

Foster Wheeler Environmental. 1998c. Quality Assurance Project Plan. Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee. Bellevue, WA.

Foster Wheeler Environmental and Anchor Environmental. 1999. Revised Final Round 1A Data Report. Prepared by Foster Wheeler Environmental and Anchor Environmental, L.L.C. for Middle Waterway Action Committee. Bellevue, WA.

Gilmur, Richard. 1998. Personal communication with Clay Patmont. September 1998.

Hart Crowser, Inc. 1992. Environmental Assessment of Outfalls, Seeps, and Tideflat Sediments, Middle Waterway, Tacoma, Washington. Prepared by Hart Crowser, Inc., Seattle, Washington for Foss Maritime and Simpson Tacoma Kraft Company, Tacoma, WA.

Hart Crowser. 1980. Geology of the Port of Tacoma. Prepared for Port of Tacoma. Seattle, WA.

Hylebos Cleanup Committee. 1998. Remedial Options for Sediment Management Areas, Hylebos Waterway Pre-Remedial Design Program. September 25, 1998.

Johnstone, A. 1986. Paxport Mills Epibenthic and Infaunal Assessment of Harpacticoid Assemblages for Salmon Enhancement.

Johnstone, A. 1985. Paxport Mills Sediment Metals Study and Benthic Infauna of Salmon Enhancement Area.

Lavelle, J.W., G.J. Massoth, and E.A. Crecelius. 1985. Sedimentation Rates in Puget Sound from ^{210}Pb measurements. NOAA Technical Memorandum ERL PMEL-61. Pacific Marine Environmental Laboratory, Seattle, WA. January 1985.

Norton, D. 1996. Commencement Bay Sediment Trap Monitoring Program: Results of Monitoring Conducted in Hylebos, Sitcum, and Thea Foss Waterways between June 1991 and June 1995. Washington Department of Ecology Report. April 1996.

Officer, C.B. and D.R. Lynch. 1982. Interpretation Procedures for the Determination of Sediment Parameters from Time-Dependent Flux Inputs. Earth and Planetary Science Letters 61, 55-62.

Officer, C.B. and D.R. Lynch. 1989. Bioturbation, Sedimentation and Sediment-Water Exchanges. Estuarine. Coastal and Shelf Science 28, 1-12.

Palermo, Michael R. 1986. Development of a Modified Elutriate Test for Estimating the Quality of Effluent from Confined Dredged Material Disposal Areas. Technical Report D-86-4. Prepared for the U.S. Army Corps of Engineers. U.S. Army Engineers Waterways Experiment Station, Environmental Laboratory, Vicksburg, MS.

Parametrix, Inc. 1998. Middle Waterway Shore Restoration Project Monitoring and Adaptive Management Plan Data Report, Post Construction (Year 3). Prepared for Simpson Tacoma Kraft Paper Company, Tacoma, WA.

Parametrix, Inc. 1996. Middle Waterway Shore Restoration Project Monitoring and Adaptive Management Plan Data Report, Post-Construction (Year 0-1). Prepared for Simpson Tacoma Kraft Company, Tacoma, Washington and Champion International, Stamford, CT.

Parametrix, Inc. 1994. Preliminary Draft Sampling Report, Puget Sound Dredged Disposal Analysis for Sediment Characterization at Middle Waterway Shore Restoration Project. Prepared by Parametrix, Inc., Bellevue, Washington for Simpson Tacoma Kraft Company, Champion International Corporation, and Natural Resource Trustees for Commencement Bay, Tacoma, WA.

Parametrix, Inc. 1993. Project Analysis Middle Waterway Shore Restoration Project Overview, EPA Environmental Checklist Technical Appendices. Prepared for Simpson Tacoma Kraft Company and Champion International Corporation.

PSEP (Puget Sound Estuary Program). 1995. Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments. Prepared by Washington Department of Ecology, Olympia, Washington for EPA, Region 10, Office of Puget Sound, Seattle, WA.

PSEP. 1987. Recommended Protocols for Sampling and Analyzing Subtidal Benthic Macroinvertebrate Assemblages in Puget Sound. Final Report. Prepared by Tetra Tech, Inc. for EPA, Region 10, Office of Puget Sound, Seattle, WA.

Tetra Tech. 1988. Commencement Bay Nearshore/Tideflats Feasibility Study. Public Review Draft. Prepared by Tetra Tech, Bellevue, Washington for EPA, Region 10, Seattle, Washington and Washington State Department of Ecology, Olympia, WA.

Tetra Tech. 1985. Commencement Bay Nearshore/Tideflats Remedial Investigation. Final Report TC-3752. Prepared by Tetra Tech, Bellevue, Washington for EPA, Region 10, Seattle, Washington and Washington State Department of Ecology, Olympia, WA.

USFWS and NOAA (United States Fish and Wildlife Service, and National Oceanographic and Atmospheric Administration). 1996. Commencement Bay Programmatic Environmental Impact Statement: Draft EIS, Volumes I and II. June 1996.

Van Genuchten, M. Th. and J.C. Parker. 1984. Boundary Conditions for Displacement Experiments through Short Laboratory Soil Columns. Soil Sci. Soc. Am. J. 48, 703-708.

TABLES

Table 1. SQO and Target Analyte List [a]

Conventional/Miscellaneous
- Total solids
- Total organic carbon
- Ammonia
- Sulfide

Metals
- Antimony
- Arsenic
- Cadmium
- Chromium [b]
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Zinc
- Tributyltin [d,e]

Phenols and Substituted Phenols
- Phenol
- 2-Methylphenol
- 4-Methylphenol
- 2,4-Dimethylphenol
- Pentachlorophenol

LPAH
- Napthalene
- 2-Methylnaphthalene
- Acenaphthylene
- Acenapthene
- Fluorene
- Phenanthrene
- Anthracene
- Total LPAH

HPAH
- Fluoranthene
- Pyrene
- Benz(a)anthracene
- Chrysene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzo(a)pyrene
- Indeno(1,2,3-cd)pyrene
- Dibenz(a,h)anthracene
- Benzo(ghi)perylene
- Total HPAH

Chlorinated Aromatic Compounds
- 1,3-Dichlorobenzene
- 1,4-Dichlorovenzene
- 1,2-Dichlorovenzene
- 1,2,4-Trichlorobenzene
- Hexachlorobenzene

Volatile Organic Compounds
- Tetrachloroethene
- Trichloroethene [c]
- Ethylbenzene
- Total xylenes

Chlorinated Aliphatic Compounds
- Hexachlorobutadiene

Phthalate Esters
- Dimethyl phthalate
- Diethyl phthalate
- Di-*n*-butyl phthalate
- Butylbenzylphthalate
- Bis(2-ethylhexyl)phthalate
- Di-*n*-octyl phthalate

Other Organic Compounds
- Benzyl alcohol
- Benzoic acid
- Dibenzofuran
- Hexachloroethane [c]
- N-nitrosodiphenylamine

Pesticides/PCBs
- Total PCBs
- 4,4'-DDE
- 4,4'-DDD
- 4,4'-DDT
- Aldrin [c]
- Chlordane [c]
- Dieldrin [c]
- Heptachlor [c]
- Lindane [c]

Tentatively Identified Compounds (TICs)
- As determined by U.S. Environmental Protection Agency (EPA)

[a] The target analyte list includes all constituents that have a CB/NT record of decision (ROD) sediment cleanup objective, an Ecology Sediment Management Standard, or a Puget Sound Dredged Disposal Analysis (PSDDA) screening level (SL) and maximum level (ML) value. CB/NT ROD sediment cleanup objectives are not available for those constituents that are marked with footnote "b" or "c."

[b] An Ecology Sediment Cleanup Standard exists for chromium.

[c] PSDDA SL and ML values exist for this constituent.

[d] PSDDA SL value exists for this constituent.

[e] Tributyltin in sediments: USEPA requires analysis of interstitial water and bulk sediment, as appropriate for TBT (as ion). An interstitial water screening value will be selected by USEPA from within the range of 0.05 µg TBT/L to 0.70 µg TBT/L (Weston, 1996a). MWAC will identify pore water samples with concentrations of TBT that exceed 0.7 µg/L TBT (ion).

Table 2. Round 1A Surface Sediment Exceedences

Chemical	Concentration	Flag	Units	SQO	EF
MW018 (MWSS018R1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	29.00		ug/kg	28	1.04
MW021 (MWSS021R1, Foster Wheeler, 1998)					
Metals					
Mercury	0.76		mg/kg	0.59	1.29
MW022 (MWSS022R1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	46.00		ug/kg	28	1.64
Metals					
Copper	637.00		mg/kg	390	1.63
Mercury	2.20	E	mg/kg	0.59	3.73
MW024 (MWSS024R1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Fluoranthene	4300.00		ug/kg	2500	1.72
Pyrene	3500.00		ug/kg	3300	1.06
Low Molecular Weight Polycyclic Hydrocarbons					
Anthracene	1000.00		ug/kg	960	1.04
MW025 (MWSS025R1, Foster Wheeler, 1998)					
Metals					
Mercury	5.90	E	mg/kg	0.59	10.00
MW026 (MWSS026R1, Foster Wheeler, 1998)					
Metals					
Arsenic	70.00		mg/kg	57	1.23
Zinc	423.00		mg/kg	410	1.03
MW027 (MWSS027R1, Foster Wheeler, 1998)					
Metals					
Mercury	0.89		mg/kg	0.59	1.51
MW028 (MWSS028R1, Foster Wheeler, 1998)					
Low Molecular Weight Polycyclic Hydrocarbons					
Fluorene	550.00		ug/kg	540	1.02
MW029 (MWSS029R1, Foster Wheeler, 1998)					
Metals					
Mercury	1.20		mg/kg	0.59	2.03
MW030 (MWSS030R1, Foster Wheeler, 1998)					
Metals					
Mercury	2.00		mg/kg	0.59	3.39

Table 2. Round 1A Surface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
MW031 (MWSS031R1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	2000.00		ug/kg	1600	1.25
Benzofluoranthenes	7800.00		ug/kg	3600	2.17
Chrysene	2900.00		ug/kg	2800	1.04
Fluoranthene	6900.00		ug/kg	2500	2.76
Pyrene	5900.00		ug/kg	3300	1.79
Total HPAH	28430.00		ug/kg	17000	1.67
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	660.00		ug/kg	500	1.32
Anthracene	1000.00		ug/kg	960	1.04
Fluorene	710.00		ug/kg	540	1.31
Phenanthrene	3700.00		ug/kg	1500	2.47
Total LPAH	7280.00		ug/kg	5200	1.40
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	43.00	U	ug/kg	28	1.54
Metals					
Mercury	0.92		mg/kg	0.59	1.56
Polychlorinated Biphenyls (PCBs)					
PCB (total)	1300.00		ug/kg	300	4.33
Pesticides					
4,4-DDE	93.00		ug/kg	9	10.33
Phthalates					
Butylbenzylphthalate	1000.00	U	ug/kg	900	1.11
MW032 (MWSS032R1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
Benzoic acid	1300.00	J	ug/kg	650	2.00
Metals					
Arsenic	97.20		mg/kg	57	1.71
Copper	1100.00	E	mg/kg	390	2.82
Mercury	4.70		mg/kg	0.59	7.97
Zinc	515.00		mg/kg	410	1.26
MW034 (MWSS034R1, Foster Wheeler, 1998)					
Metals					
Mercury	0.74		mg/kg	0.59	1.25
Phenols					
Phenol	620.00	E	ug/kg	420	1.48

Table 2. Round 1A Surface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
MW035 (MWSS035R1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	32.00	U	ug/kg	28	1.14
Metals					
Mercury	1.10		mg/kg	0.59	1.86
MW037 (MWSS037R1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	66.00		ug/kg	28	2.36
Metals					
Mercury	1.40	E	mg/kg	0.59	2.37
MW039 (MWST039R1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	1800.00		ug/kg	1600	1.13
Benzo(g,h,i)perylene	990.00		ug/kg	720	1.38
Benzofluoranthenes	4800.00		ug/kg	3600	1.33
Fluoranthene	7800.00		ug/kg	2500	3.12
Indeno(1,2,3-cd)pyrene	740.00		ug/kg	690	1.07
Pyrene	4900.00		ug/kg	3300	1.48
Total HPAH	24470.00		ug/kg	17000	1.44
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	1200.00		ug/kg	500	2.40
Anthracene	1700.00		ug/kg	960	1.77
Fluorene	1500.00		ug/kg	540	2.78
Phenanthrene	3200.00		ug/kg	1500	2.13
Total LPAH	10220.00		ug/kg	5200	1.97
Miscellaneous Extractable Compounds					
Dibenzofuran	1200.00		ug/kg	540	2.22
MW042 (MWST042R1, Foster Wheeler, 1998)					
Metals					
Mercury	1.00	E	mg/kg	0.59	1.69
MW044 (MWST044R1, Foster Wheeler, 1998)					
Metals					
Mercury	2.60	E	mg/kg	0.59	4.41
MW045 (MWST045R1, Foster Wheeler, 1998)					
Metals					
Mercury	0.85		mg/kg	0.59	1.44

Table 2. Round 1A Surface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
MW047 (MWST047R1, Foster Wheeler, 1998)					
Metals					
Mercury	1.70	*N	mg/kg	0.59	2.88
Phenols					
4-Methylphenol	690.00		ug/kg	670	1.03
MW048 (MWST048R1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)pyrene	1700.00	E	ug/kg	1600	1.06
Benzo(g,h,i)perylene	750.00		ug/kg	720	1.04
Benzofluoranthenes	4800.00		ug/kg	3600	1.33
Fluoranthene	3200.00		ug/kg	2500	1.28
Pyrene	3600.00		ug/kg	3300	1.09
Total HPAH	18120.00		ug/kg	17000	1.07
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	1100.00		ug/kg	500	2.20
Fluorene	840.00		ug/kg	540	1.56
Naphthalene	2800.00		ug/kg	2100	1.33
Phenanthrene	2500.00		ug/kg	1500	1.67
Total LPAH	8970.00		ug/kg	5200	1.73
MW051 (MWST051R1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	6300.00		ug/kg	1600	3.94
Benzo(a)pyrene	6400.00		ug/kg	1600	4.00
Benzo(g,h,i)perylene	3800.00		ug/kg	720	5.28
Benzofluoranthenes	24000.00		ug/kg	3600	6.67
Chrysene	6400.00		ug/kg	2800	2.29
Fluoranthene	13000.00		ug/kg	2500	5.20
Indeno(1,2,3-cd)pyrene	3400.00		ug/kg	690	4.93
Pyrene	15000.00	E	ug/kg	3300	4.55
Total HPAH	78300.00		ug/kg	17000	4.61
Low Molecular Weight Polycyclic Hydrocarbons					
2-Methylnaphthalene	1400.00		ug/kg	670	2.09
Acenaphthene	4600.00		ug/kg	500	9.20
Acenaphthylene	1600.00		ug/kg	1300	1.23
Anthracene	2600.00		ug/kg	960	2.71
Fluorene	3800.00		ug/kg	540	7.04
Naphthalene	5300.00		ug/kg	2100	2.52

Table 2. Round 1A Surface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Phenanthrene	13000.00		ug/kg	1500	8.67
Total LPAH	32300.00		ug/kg	5200	6.21
Miscellaneous Extractable Compounds					
Dibenzofuran	2900.00		ug/kg	540	5.37
N-Nitrosodiphenylamine	190.00	J	ug/kg	28	6.79
Metals					
Mercury	0.92	E	mg/kg	0.59	1.56
Phenols					
2,4-Dimethylphenol	100.00		ug/kg	29	3.45
2-Methylphenol	77.00		ug/kg	63	1.22
MW052 (MWST052R1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	83.00		ug/kg	28	2.96
MW054 (MWST054R1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	1800.00		ug/kg	1600	1.13
Benzofluoranthenes	5600.00		ug/kg	3600	1.56
Fluoranthene	4400.00		ug/kg	2500	1.76
Indeno(1,2,3-cd)pyrene	1200.00		ug/kg	690	1.74
Pyrene	5000.00		ug/kg	3300	1.52
Total HPAH	20620.00		ug/kg	17000	1.21
Low Molecular Weight Polycyclic Hydrocarbons					
2-Methylnaphthalene	910.00		ug/kg	670	1.36
Acenaphthene	580.00		ug/kg	500	1.16
Anthracene	1500.00		ug/kg	960	1.56
Fluorene	1100.00		ug/kg	540	2.04
Naphthalene	4200.00		ug/kg	2100	2.00
Phenanthrene	4100.00		ug/kg	1500	2.73
Total LPAH	13080.00		ug/kg	5200	2.52
Miscellaneous Extractable Compounds					
Dibenzofuran	580.00		ug/kg	540	1.07
Metals					
Mercury	0.83	E	mg/kg	0.59	1.41
Phenols					
2,4-Dimethylphenol	54.00		ug/kg	29	1.86

Table 2. Round 1A Surface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
MW055 (MWSS055R1, Foster Wheeler, 1998)					
Metals					
Copper	402.00		mg/kg	390	1.03
Mercury	2.90	E	mg/kg	0.59	4.92
TF-20 (TF-20, City of Tacoma, 1997)					
Chlorinated Aromatic Compounds					
1,2-Dichlorobenzene	99.00	U	ug/kg	50	1.98
TF-21 (TF-21A, City of Tacoma, 1997)					
Metals					
Mercury	0.82	J	mg/kg	0.59	1.39
Phthalates					
bis(2-Ethylhexyl)phthalate	1600.00		ug/kg	1300	1.23
TF-22 (TF-22A, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	3100.00		ug/kg	1600	1.94
Benzo(a)pyrene	3500.00		ug/kg	1600	2.19
Benzo(g,h,i)perylene	1900.00		ug/kg	720	2.64
Benzofluoranthenes	7100.00		ug/kg	3600	1.97
Chrysene	4700.00		ug/kg	2800	1.68
Dibenzo(a,h)anthracene	650.00		ug/kg	230	2.83
Fluoranthene	4100.00		ug/kg	2500	1.64
Indeno(1,2,3-cd)pyrene	1600.00		ug/kg	690	2.32
Pyrene	3400.00		ug/kg	3300	1.03
Total HPAH	30050.00		ug/kg	17000	1.77
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	2200.00		ug/kg	1500	1.47
Metals					
Mercury	0.69	J	mg/kg	0.59	1.17
Phthalates					
bis(2-Ethylhexyl)phthalate	3500.00		ug/kg	1300	2.69
TF-23 (TF-23, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(g,h,i)perylene	750.00		ug/kg	720	1.04
Metals					
Copper	398.00	J	mg/kg	390	1.02
Mercury	2.26	J	mg/kg	0.59	3.83

Table 2. Round 1A Surface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Polychlorinated Biphenyls (PCBs)					
PCB (total)	480.00		ug/kg	300	1.60
Pesticides					
4,4-DDT	40.00	U	ug/kg	34	1.18

SQO - Sediment Quality Objective
EF - Exceednace Factor = Concentration divided by SQO
* - Duplicate analysis not within control limits
E - Estimated
J - Estimated Value
N - Spiked sample recovery not within control limits
U - Value not detected

Table 3. Round 1A Subsurface Sediment Exceedences

Chemical	Concentration	Flag	Units	SQO	EF
MW024 (MWCS024R2A, 1.5 - 4 ft , Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Fluoranthene	6600.00		ug/kg	2500	2.64
Pyrene	4400.00		ug/kg	3300	1.33
Total HPAH	17700.00		ug/kg	17000	1.04
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	730.00		ug/kg	500	1.46
Anthracene	1200.00		ug/kg	960	1.25
Fluorene	730.00		ug/kg	540	1.35
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	34.00	U	ug/kg	28	1.21
Pesticides					
4,4-DDE	11.00	E	ug/kg	9	1.22
MW025 (MWCS025R2A, 0.4 - 5 ft , Foster Wheeler, 1998)					
Metals					
Mercury	1.20		mg/kg	0.59	2.03
MW027 (MWCS027R2A, 1 - 3.8 ft , Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Fluoranthene	3200.00		ug/kg	2500	1.28
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	660.00		ug/kg	500	1.32
Fluorene	860.00		ug/kg	540	1.59
Phenanthrene	1700.00		ug/kg	1500	1.13
Total LPAH	5580.00		ug/kg	5200	1.07
Metals					
Antimony	467.00	E	mg/kg	150	3.11
Arsenic	130.00		mg/kg	57	2.28
Copper	2900.00		mg/kg	390	7.44
Mercury	6.00		mg/kg	0.59	10.17
Silver	39.70		mg/kg	6.1	6.51
Zinc	560.00		mg/kg	410	1.37
Pesticides					
4,4-DDD	18.00	P	ug/kg	16	1.13
4,4-DDE	9.80	P	ug/kg	9	1.09
Phenols					
2,4-Dimethylphenol	62.00		ug/kg	29	2.14

Table 3. Round 1A Subsurface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
MW027 (MWCS027R3A, 3.8 - 7 ft , Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Fluoranthene	4300.00		ug/kg	2500	1.72
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	1500.00		ug/kg	500	3.00
Anthracene	2200.00		ug/kg	960	2.29
Fluorene	3000.00		ug/kg	540	5.56
Phenanthrene	6600.00		ug/kg	1500	4.40
Total LPAH	14356.00		ug/kg	5200	2.76
Miscellaneous Extractable Compounds					
Dibenzofuran	1000.00		ug/kg	540	1.85
N-Nitrosodiphenylamine	33.00	U	ug/kg	28	1.18
MW027 (MWCS027R4A, 7 - 11.5 ft , Foster Wheeler, 1998)					
Phenols					
2,4-Dimethylphenol	36.00		ug/kg	29	1.24
MW030 (MWCS030R2A, 0.5 - 5.5 ft , Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	4500.00		ug/kg	1600	2.81
Benzo(a)pyrene	2400.00		ug/kg	1600	1.50
Benzo(g,h,i)perylene	1600.00		ug/kg	720	2.22
Benzofluoranthenes	8200.00		ug/kg	3600	2.28
Chrysene	4900.00		ug/kg	2800	1.75
Dibenzo(a,h)anthracene	590.00		ug/kg	230	2.57
Fluoranthene	18000.00		ug/kg	2500	7.20
Indeno(1,2,3-cd)pyrene	1300.00		ug/kg	690	1.88
Pyrene	12000.00		ug/kg	3300	3.64
Total HPAH	53490.00		ug/kg	17000	3.15
Low Molecular Weight Polycyclic Hydrocarbons					
2-Methylnaphthalene	1200.00		ug/kg	670	1.79
Acenaphthene	7200.00		ug/kg	500	14.40
Anthracene	4300.00		ug/kg	960	4.48
Fluorene	12000.00		ug/kg	540	22.22
Naphthalene	4000.00		ug/kg	2100	1.90
Phenanthrene	25000.00		ug/kg	1500	16.67
Total LPAH	54380.00		ug/kg	5200	10.46
Miscellaneous Extractable Compounds					
Dibenzofuran	4800.00		ug/kg	540	8.89

Table 3. Round 1A Subsurface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
N-Nitrosodiphenylamine	160.00	U	ug/kg	28	5.71
Metals					
Mercury	0.64		mg/kg	0.59	1.08
Phenols					
2,4-Dimethylphenol	50.00		ug/kg	29	1.72
MW030 (MWCS030R3A, 7 - 9 ft , Foster Wheeler, 1998)					
Phenols					
2,4-Dimethylphenol	37.00		ug/kg	29	1.28
MW031 (MWCS031R2A, 1.7 - 4 ft , Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	3000.00		ug/kg	1600	1.88
Benzo(a)pyrene	2300.00		ug/kg	1600	1.44
Benzo(g,h,i)perylene	1500.00		ug/kg	720	2.08
Benzofluoranthenes	10000.00		ug/kg	3600	2.78
Chrysene	3300.00		ug/kg	2800	1.18
Dibenzo(a,h)anthracene	690.00		ug/kg	230	3.00
Fluoranthene	3200.00		ug/kg	2500	1.28
Indeno(1,2,3-cd)pyrene	1400.00		ug/kg	690	2.03
Pyrene	4900.00	E	ug/kg	3300	1.48
Total HPAH	30290.00		ug/kg	17000	1.78
Low Molecular Weight Polycyclic Hydrocarbons					
Anthracene	3600.00		ug/kg	960	3.75
Fluorene	900.00		ug/kg	540	1.67
Phenanthrene	2800.00		ug/kg	1500	1.87
Total LPAH	9210.00		ug/kg	5200	1.77
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	54.00	U	ug/kg	28	1.93
Metals					
Copper	1060.00		mg/kg	390	2.72
Lead	1020.00	E	mg/kg	450	2.27
Mercury	9.00		mg/kg	0.59	15.25
Pesticides					
4,4-DDD	36.00	P	ug/kg	16	2.25
4,4-DDT	71.00	E	ug/kg	34	2.09
Phenols					
2,4-Dimethylphenol	98.00		ug/kg	29	3.38
Phenol	570.00	B	ug/kg	420	1.36

Table 3. Round 1A Subsurface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
MW031 (MWCS031R3A, 4 - 5.6 ft , Foster Wheeler, 1998)					
Phenols					
2,4-Dimethylphenol	34.00		ug/kg	29	1.17
MW035 (MWCS035R3A, 1.5 - 8 ft , Foster Wheeler, 1998)					
Phthalates					
Diethylphthalate	1100.00		ug/kg	200	5.50
MW037 (MWCS037R2A, 1 - 4.7 ft , Foster Wheeler, 1998)					
Metals					
Mercury	1.30		mg/kg	0.59	2.20
TF-22 (TF-22B, 0.2952 - 1.5088 ft , City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	1900.00		ug/kg	1600	1.19
Benzo(a)pyrene	2000.00		ug/kg	1600	1.25
Benzo(g,h,i)perylene	960.00		ug/kg	720	1.33
Fluoranthene	3900.00		ug/kg	2500	1.56
Indeno(1,2,3-cd)pyrene	730.00		ug/kg	690	1.06
Pyrene	3900.00		ug/kg	3300	1.18
Total HPAH	18090.00		ug/kg	17000	1.06
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	2700.00		ug/kg	1500	1.80
Metals					
Mercury	1.26	J	mg/kg	0.59	2.14
Zinc	558.00	J	mg/kg	410	1.36
TF-22 (TF-22C, 1.5088 - 2.6896 ft , City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	32000.00		ug/kg	1600	20.00
Benzo(a)pyrene	35000.00		ug/kg	1600	21.88
Benzo(g,h,i)perylene	20000.00		ug/kg	720	27.78
Benzofluoranthenes	38000.00		ug/kg	3600	10.56
Chrysene	31000.00		ug/kg	2800	11.07
Dibenzo(a,h)anthracene	4500.00		ug/kg	230	19.57
Fluoranthene	71000.00		ug/kg	2500	28.40
Indeno(1,2,3-cd)pyrene	15000.00		ug/kg	690	21.74
Pyrene	82000.00		ug/kg	3300	24.85
Total HPAH	328500.00		ug/kg	17000	19.32
Low Molecular Weight Polycyclic Hydrocarbons					
2-Methylnaphthalene	2700.00		ug/kg	670	4.03

Table 3. Round 1A Subsurface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Acenaphthene	45000.00		ug/kg	500	90.00
Acenaphthylene	6300.00		ug/kg	1300	4.85
Anthracene	27000.00		ug/kg	960	28.13
Fluorene	26000.00		ug/kg	540	48.15
Naphthalene	8600.00		ug/kg	2100	4.10
Phenanthrene	130000.00		ug/kg	1500	86.67
Total LPAH	242900.00		ug/kg	5200	46.71
Miscellaneous Extractable Compounds					
Dibenzofuran	4600.00		ug/kg	540	8.52
Metals					
Lead	2750.00		mg/kg	450	6.11
Zinc	580.00	J	mg/kg	410	1.41
Pesticides					
4,4-DDT	40.00	U	ug/kg	34	1.18
HC-2 (S-1, 0 - 0.8856 ft , Hart Crowser, 1992b)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	2700.00	D	ug/kg	1600	1.69
Benzo(g,h,i)perylene	820.00	D	ug/kg	720	1.14
Dibenzo(a,h)anthracene	580.00	D	ug/kg	230	2.52
Fluoranthene	2800.00	D	ug/kg	2500	1.12
Indeno(1,2,3-cd)pyrene	970.00	D	ug/kg	690	1.41
Pyrene	8300.00	D	ug/kg	3300	2.52
Total HPAH	22680.00		ug/kg	17000	1.33
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	1300.00	UD	ug/kg	500	2.60
Acenaphthylene	4500.00	UD	ug/kg	1300	3.46
Phenanthrene	2400.00	D	ug/kg	1500	1.60
Metals					
Mercury	1.20		mg/kg	0.59	2.03
HC-2 (S-2, 0.8856 - 1.9024 ft , Hart Crowser, 1992b)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	2400.00	D	ug/kg	1600	1.50
Benzo(g,h,i)perylene	730.00	D	ug/kg	720	1.01
Dibenzo(a,h)anthracene	360.00	D	ug/kg	230	1.57
Indeno(1,2,3-cd)pyrene	740.00	D	ug/kg	690	1.07
Pyrene	7800.00	D	ug/kg	3300	2.36
Total HPAH	19350.00		ug/kg	17000	1.14

Table 3. Round 1A Subsurface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	820.00	UD	ug/kg	500	1.64
Acenaphthylene	2900.00	UD	ug/kg	1300	2.23
Phenanthrene	1700.00	D	ug/kg	1500	1.13
MW-1 (1, 0 - 1 ft , Hart Crowser, 1992a)					
Chlorinated Aromatic Compounds					
1,2,4-Trichlorobenzene	97.00	U	ug/kg	51	1.90
1,2-Dichlorobenzene	97.00	U	ug/kg	50	1.94
Hexachlorobenzene	97.00	U	ug/kg	22	4.41
Chlorinated Aliphatic Compound					
Hexachlorobutadiene	190.00	U	ug/kg	11	17.27
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(g,h,i)perylene	1100.00		ug/kg	720	1.53
Dibenzo(a,h)anthracene	370.00		ug/kg	230	1.61
Indeno(1,2,3-cd)pyrene	1100.00		ug/kg	690	1.59
Miscellaneous Extractable Compounds					
Benzoic acid	970.00	U	ug/kg	650	1.49
Benzyl alcohol	480.00	U	ug/kg	73	6.58
N-Nitrosodiphenylamine	97.00	U	ug/kg	28	3.46
Metals					
Mercury	2.42		mg/kg	0.59	4.10
Phenols					
2,4-Dimethylphenol	190.00	U	ug/kg	29	6.55
2-Methylphenol	97.00	U	ug/kg	63	1.54
Pentachlorophenol	480.00	U	ug/kg	360	1.33
MW-1 (2, 1.0168 - 2.0008 ft , Hart Crowser, 1992a)					
Chlorinated Aromatic Compounds					
1,2,4-Trichlorobenzene	100.00	U	ug/kg	51	1.96
1,2-Dichlorobenzene	100.00	U	ug/kg	50	2.00
Hexachlorobenzene	100.00	U	ug/kg	22	4.55
Chlorinated Aliphatic Compound					
Hexachlorobutadiene	200.00	U	ug/kg	11	18.18
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	2400.00		ug/kg	1600	1.50
Benzo(a)pyrene	4100.00		ug/kg	1600	2.56
Benzo(g,h,i)perylene	3400.00		ug/kg	720	4.72
Benzofluoranthenes	4700.00		ug/kg	3600	1.31

Table 3. Round 1A Subsurface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Dibenzo(a,h)anthracene	780.00		ug/kg	230	3.39
Fluoranthene	3800.00		ug/kg	2500	1.52
Indeno(1,2,3-cd)pyrene	2900.00		ug/kg	690	4.20
Pyrene	6000.00		ug/kg	3300	1.82
Total HPAH	30680.00		ug/kg	17000	1.80
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	2000.00		ug/kg	1500	1.33
Miscellaneous Extractable Compounds					
Benzoic acid	1000.00	U	ug/kg	650	1.54
Benzyl alcohol	510.00	U	ug/kg	73	6.99
N-Nitrosodiphenylamine	100.00	U	ug/kg	28	3.57
Metals					
Mercury	0.61		mg/kg	0.59	1.03
Phenols					
2,4-Dimethylphenol	200.00	U	ug/kg	29	6.90
2-Methylphenol	100.00	U	ug/kg	63	1.59
Pentachlorophenol	510.00	U	ug/kg	360	1.42
MW040 (MWCS040R2A, 1.2 - 3.5 ft , Foster Wheeler, 1998)					
Metals					
Mercury	1.20		mg/kg	0.59	2.03
MW041 (MWCT041R2, 0 - 2 ft , Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	60.00		ug/kg	28	2.14
Metals					
Mercury	0.92	E	mg/kg	0.59	1.56
MW046 (MWCT046R2, 0 - 2 ft , Foster Wheeler, 1998)					
Metals					
Mercury	0.98	E	mg/kg	0.59	1.66
MW050 (MWCT050R2, 0 - 2 ft , Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	5300.00		ug/kg	1600	3.31
Benzo(a)pyrene	5100.00		ug/kg	1600	3.19
Benzo(g,h,i)perylene	1200.00		ug/kg	720	1.67
Benzofluoranthenes	13400.00		ug/kg	3600	3.72
Chrysene	5500.00		ug/kg	2800	1.96
Dibenzo(a,h)anthracene	610.00		ug/kg	230	2.65
Fluoranthene	12000.00		ug/kg	2500	4.80

Table 3. Round 1A Subsurface Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Indeno(1,2,3-cd)pyrene	1300.00		ug/kg	690	1.88
Pyrene	10000.00	E	ug/kg	3300	3.03
Total HPAH	54410.00		ug/kg	17000	3.20
Low Molecular Weight Polycyclic Hydrocarbons					
2-Methylnaphthalene	3100.00		ug/kg	670	4.63
Acenaphthene	4000.00		ug/kg	500	8.00
Acenaphthylene	1700.00		ug/kg	1300	1.31
Anthracene	6300.00		ug/kg	960	6.56
Fluorene	5800.00		ug/kg	540	10.74
Naphthalene	11000.00		ug/kg	2100	5.24
Phenanthrene	12000.00		ug/kg	1500	8.00
Total LPAH	43900.00		ug/kg	5200	8.44
Miscellaneous Extractable Compounds					
Dibenzofuran	2200.00		ug/kg	540	4.07
N-Nitrosodiphenylamine	38.00	U	ug/kg	28	1.36
Phenols					
2,4-Dimethylphenol	37.00		ug/kg	29	1.28

SQO - Sediment Quality Objective

EF - Exceednace Factor = Concentration divided by SQO

B - Analyte detected in samples and in method blank

D - Value was from an anlysis at a secondary dilution factor

E - Estimated

J - Estimated Value

P - The percent difference in sample concentration between the two GC columns is > 25%

U - Value not detected

Table 4. Round 1A Bank Sediment Exceedences

Chemical	Concentration	Flag	Units	SQO	EF
B-12 (B-12, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(g,h,i)perylene	980.00		ug/kg	720	1.36
Dibenzo(a,h)anthracene	280.00		ug/kg	230	1.22
Indeno(1,2,3-cd)pyrene	870.00		ug/kg	690	1.26
Metals					
Arsenic	76.00		mg/kg	57	1.33
Copper	977.00	J	mg/kg	390	2.51
Zinc	1590.00	J	mg/kg	410	3.88
B-14 (B-14, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	15000.00		ug/kg	1600	9.38
Benzo(a)pyrene	16000.00		ug/kg	1600	10.00
Benzo(g,h,i)perylene	5000.00		ug/kg	720	6.94
Benzofluoranthenes	19000.00		ug/kg	3600	5.28
Chrysene	16000.00		ug/kg	2800	5.71
Dibenzo(a,h)anthracene	1800.00		ug/kg	230	7.83
Fluoranthene	22000.00		ug/kg	2500	8.80
Indeno(1,2,3-cd)pyrene	4400.00		ug/kg	690	6.38
Pyrene	270000.00		ug/kg	3300	81.82
Total HPAH	369200.00		ug/kg	17000	21.72
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	940.00		ug/kg	500	1.88
Anthracene	3700.00		ug/kg	960	3.85
Fluorene	1200.00		ug/kg	540	2.22
Phenanthrene	20000.00		ug/kg	1500	13.33
Total LPAH	27170.00		ug/kg	5200	5.22
Metals					
Copper	1430.00	J	mg/kg	390	3.67
Nickel	389.00		mg/kg	140	2.78
Zinc	535.00	J	mg/kg	410	1.30
Polychlorinated Biphenyls (PCBs)					
PCB (total)	690.00		ug/kg	300	2.30
B-15 (B-15, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	3500.00		ug/kg	1600	2.19
Benzo(a)pyrene	4600.00		ug/kg	1600	2.88

Table 4. Round 1A Bank Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Benzo(g,h,i)perylene	2900.00		ug/kg	720	4.03
Benzofluoranthenes	7000.00		ug/kg	3600	1.94
Chrysene	3700.00		ug/kg	2800	1.32
Dibenzo(a,h)anthracene	830.00		ug/kg	230	3.61
Fluoranthene	4300.00		ug/kg	2500	1.72
Indeno(1,2,3-cd)pyrene	2500.00		ug/kg	690	3.62
Pyrene	6100.00	J	ug/kg	3300	1.85
Total HPAH	35430.00		ug/kg	17000	2.08
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	4100.00		ug/kg	1500	2.73
Total LPAH	5990.00		ug/kg	5200	1.15
Metals					
Copper	1730.00	J	mg/kg	390	4.44
Mercury	10.90	J	mg/kg	0.59	18.47
Nickel	1780.00		mg/kg	140	12.71
Zinc	1180.00	J	mg/kg	410	2.88
Polychlorinated Biphenyls (PCBs)					
PCB (total)	2800.00		ug/kg	300	9.33
Phthalates					
Dimethylphthalate	320.00		ug/kg	160	2.00
B-16 (B-16, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	2600.00		ug/kg	1600	1.63
Benzo(a)pyrene	2900.00		ug/kg	1600	1.81
Benzo(g,h,i)perylene	1700.00		ug/kg	720	2.36
Benzofluoranthenes	4400.00		ug/kg	3600	1.22
Chrysene	3100.00		ug/kg	2800	1.11
Dibenzo(a,h)anthracene	470.00		ug/kg	230	2.04
Fluoranthene	3600.00		ug/kg	2500	1.44
Indeno(1,2,3-cd)pyrene	1400.00		ug/kg	690	2.03
Pyrene	5200.00	J	ug/kg	3300	1.58
Total HPAH	25370.00		ug/kg	17000	1.49
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	4400.00		ug/kg	1500	2.93
Total LPAH	6020.00		ug/kg	5200	1.16
Metals					
Zinc	468.00	J	mg/kg	410	1.14

Table 4. Round 1A Bank Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
B-17 (B-17, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(g,h,i)perylene	870.00		ug/kg	720	1.21
Dibenzo(a,h)anthracene	280.00		ug/kg	230	1.22
Indeno(1,2,3-cd)pyrene	710.00		ug/kg	690	1.03
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	1800.00		ug/kg	1500	1.20
B-18 (B-18, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	4000.00		ug/kg	1600	2.50
Benzo(a)pyrene	5800.00		ug/kg	1600	3.63
Benzo(g,h,i)perylene	4200.00		ug/kg	720	5.83
Benzofluoranthenes	8200.00		ug/kg	3600	2.28
Chrysene	4500.00		ug/kg	2800	1.61
Dibenzo(a,h)anthracene	1300.00		ug/kg	230	5.65
Fluoranthene	3600.00		ug/kg	2500	1.44
Indeno(1,2,3-cd)pyrene	3800.00		ug/kg	690	5.51
Pyrene	5000.00	J	ug/kg	3300	1.52
Total HPAH	40400.00		ug/kg	17000	2.38
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	2000.00		ug/kg	1500	1.33
B-19 (B-19, City of Tacoma, 1997)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	4700.00		ug/kg	1600	2.94
Benzo(a)pyrene	5000.00		ug/kg	1600	3.13
Benzo(g,h,i)perylene	2800.00		ug/kg	720	3.89
Benzofluoranthenes	6800.00		ug/kg	3600	1.89
Chrysene	5400.00		ug/kg	2800	1.93
Dibenzo(a,h)anthracene	890.00		ug/kg	230	3.87
Fluoranthene	6400.00		ug/kg	2500	2.56
Indeno(1,2,3-cd)pyrene	2200.00		ug/kg	690	3.19
Pyrene	8500.00		ug/kg	3300	2.58
Total HPAH	42690.00		ug/kg	17000	2.51
Low Molecular Weight Polycyclic Hydrocarbons					
Anthracene	1400.00		ug/kg	960	1.46
Fluorene	590.00		ug/kg	540	1.09
Phenanthrene	5000.00		ug/kg	1500	3.33

Table 4. Round 1A Bank Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Total LPAH	8750.00		ug/kg	5200	1.68
Phthalates					
bis(2-Ethylhexyl)phthalate	1400.00		ug/kg	1300	1.08
MW001 (MWSB001R1, Foster Wheeler, 1998)					
Phenols					
2,4-Dimethylphenol	43.00	UE	ug/kg	29	1.48
2-Methylphenol	77.00	U	ug/kg	63	1.22
MW008 (MWSB008R1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
Benzyl alcohol	99.00	E	ug/kg	73	1.36
MW008-SP (MWSB008R1 SP, Foster Wheeler, 1998)					
Polychlorinated Biphenyls (PCBs)					
PCB (total)	750.00		ug/kg	300	2.50
Pesticides					
4,4-DDE	22.00	P	ug/kg	9	2.44
4,4-DDT	38.00	P	ug/kg	34	1.12
MW009 (MWSB009R1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	3400.00		ug/kg	1600	2.13
Benzo(a)pyrene	2400.00		ug/kg	1600	1.50
Benzofluoranthenes	10000.00		ug/kg	3600	2.78
Chrysene	3200.00		ug/kg	2800	1.14
Fluoranthene	7800.00		ug/kg	2500	3.12
Pyrene	5500.00		ug/kg	3300	1.67
Total HPAH	33560.00		ug/kg	17000	1.97
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	2300.00		ug/kg	1500	1.53
Metals					
Mercury	2.00		mg/kg	0.59	3.39
MW009-SP (MWSB009R1 SP, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzofluoranthenes	6000.00		ug/kg	3600	1.67
Fluoranthene	2900.00		ug/kg	2500	1.16
Indeno(1,2,3-cd)pyrene	740.00		ug/kg	690	1.07
Total HPAH	17779.00		ug/kg	17000	1.05
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	1700.00		ug/kg	1500	1.13

Table 4. Round 1A Bank Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Metals					
Copper	408.00		mg/kg	390	1.05
Mercury	1.60		mg/kg	0.59	2.71
Zinc	480.00		mg/kg	410	1.17
MW012 (MWSB012R1, Foster Wheeler, 1998)					
Metals					
Mercury	1.30	*	mg/kg	0.59	2.20
MW013 (MWSB013R1, Foster Wheeler, 1998)					
Metals					
Copper	1090.00	N	mg/kg	390	2.79
Mercury	2.30	*	mg/kg	0.59	3.90
MW014 (MWSB014R1, Foster Wheeler, 1998)					
Metals					
Mercury	0.76	*	mg/kg	0.59	1.29
MW015 (MWSB015R1, Foster Wheeler, 1998)					
Phenols					
2-Methylphenol	89.00	U	ug/kg	63	1.41
MW03a (MWSB03aR1, Foster Wheeler, 1998)					
Low Molecular Weight Polycyclic Hydrocarbons					
Acenaphthene	670.00		ug/kg	500	1.34
Metals					
Mercury	0.87		mg/kg	0.59	1.47
Polychlorinated Biphenyls (PCBs)					
PCB (total)	690.00		ug/kg	300	2.30
Pesticides					
4,4-DDD	23.00	P	ug/kg	16	1.44
MW03b (MWSB03bR1, Foster Wheeler, 1998)					
Phenols					
2,4-Dimethylphenol	80.00	E	ug/kg	29	2.76
Pentachlorophenol	800.00		ug/kg	360	2.22
MW04b-SP (MWSB04bR1 SP, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
Benzoic acid	990.00	E	ug/kg	650	1.52
Benzyl alcohol	85.00	E	ug/kg	73	1.16
Metals					
Mercury	0.68		mg/kg	0.59	1.15

Table 4. Round 1A Bank Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Phenols					
2-Methylphenol	260.00		ug/kg	63	4.13
MW10a (MWSB10aR1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	1900.00		ug/kg	1600	1.19
Benzo(g,h,i)perylene	730.00		ug/kg	720	1.01
Benzofluoranthenes	6200.00		ug/kg	3600	1.72
Dibenzo(a,h)anthracene	360.00		ug/kg	230	1.57
Fluoranthene	4300.00		ug/kg	2500	1.72
Indeno(1,2,3-cd)pyrene	780.00		ug/kg	690	1.13
Total HPAH	20770.00		ug/kg	17000	1.22
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	2400.00		ug/kg	1500	1.60
Miscellaneous Extractable Compounds					
Benzoic acid	730.00	B	ug/kg	650	1.12
Metals					
Arsenic	166.00		mg/kg	57	2.91
Copper	2150.00	N	mg/kg	390	5.51
Lead	777.00		mg/kg	450	1.73
Mercury	1.80	*	mg/kg	0.59	3.05
Zinc	1390.00	N	mg/kg	410	3.39
MW10b (MWSB10bR1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)anthracene	1800.00		ug/kg	1600	1.13
Benzofluoranthenes	7400.00		ug/kg	3600	2.06
Total HPAH	19084.00		ug/kg	17000	1.12
Metals					
Arsenic	130.00		mg/kg	57	2.28
Copper	1370.00	N	mg/kg	390	3.51
Lead	3220.00		mg/kg	450	7.16
Mercury	1.90	*	mg/kg	0.59	3.22
Silver	6.20		mg/kg	6.1	1.02
Zinc	1330.00	N	mg/kg	410	3.24
Phenols					
Pentachlorophenol	680.00		ug/kg	360	1.89

Table 4. Round 1A Bank Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
MW10c (MWSB10cR1, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzo(a)pyrene	1800.00		ug/kg	1600	1.13
Benzo(g,h,i)perylene	1300.00		ug/kg	720	1.81
Benzofluoranthenes	7800.00		ug/kg	3600	2.17
Fluoranthene	2900.00		ug/kg	2500	1.16
Indeno(1,2,3-cd)pyrene	1200.00		ug/kg	690	1.74
Total HPAH	21693.00		ug/kg	17000	1.28
Low Molecular Weight Polycyclic Hydrocarbons					
Phenanthrene	2400.00		ug/kg	1500	1.60
Metals					
Arsenic	131.00		mg/kg	57	2.30
Copper	1660.00	N	mg/kg	390	4.26
Lead	1790.00		mg/kg	450	3.98
Mercury	29.20	*	mg/kg	0.59	49.49
Zinc	1140.00	N	mg/kg	410	2.78
Polychlorinated Biphenyls (PCBs)					
PCB (total)	410.00		ug/kg	300	1.37
Pesticides					
4,4-DDE	10.00	U	ug/kg	9	1.11
Phenols					
2,4-Dimethylphenol	63.00		ug/kg	29	2.17
Phenol	510.00		ug/kg	420	1.21
MW11a (MWSB11aR1, Foster Wheeler, 1998)					
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	35.00	J	ug/kg	28	1.25
Metals					
Mercury	4.20	*	mg/kg	0.59	7.12
MW11a-SP (MWSB11aR1 SP, Foster Wheeler, 1998)					
High Molecular Weight Polycyclic Hydrocarbons					
Benzofluoranthenes	3800.00		ug/kg	3600	1.06
Fluoranthene	2800.00		ug/kg	2500	1.12
Miscellaneous Extractable Compounds					
N-Nitrosodiphenylamine	61.00	J	ug/kg	28	2.18
Metals					
Arsenic	121.00		mg/kg	57	2.12
Copper	605.00	N	mg/kg	390	1.55

Table 4. Round 1A Bank Sediment Exceedences (Continued)

Chemical	Concentration	Flag	Units	SQO	EF
Mercury	2.50	*	mg/kg	0.59	4.24
Zinc	991.00	N	mg/kg	410	2.42
MW11b (MWSB11bR1, Foster Wheeler, 1998)					
Metals					
Mercury	0.62	*	mg/kg	0.59	1.05

SQO - Sediment Quality Objective

EF - Exceednace Factor = Concentration divided by SQO

* - Duplicate analysis not within control limits

B - Analyte found in the associated blank as well as the sample

E - Estimated due to exceedance of linear range of calibration of the instrument

J - Estimated Value

N - Spiked sample recovery not within control limits

P - The percent difference in sample concentration between the two GC columns is > 25%

U - Value not detected

Table 5. Tributyltin[1] Results (ug/L)

Sample Name	Unfiltered Concentration		Filtered[2] Concentration	
MWSS022R1	0.1			
MWSS024R1	0.05	U	0.05	U
MWSS025R1	0.05	U	0.05	U
MWSS028R1	0.05			
MWSS030R1	0.086			
MWSS031R1	0.089			
MWSS032R1	0.401			
MWSS034R1	0.043			
MWSS035R1	0.23			
MWST039R1	0.05	U		
MWST040R1	0.06		0.05	U
MWST043R1	0.05	U	0.05	U
MWST047R1	0.05	U	0.05	U
MWST048R1	0.05	U	0.05	U
MWST051R1	0.05	U	0.05	U
MWST054R1	0.05	U	0.05	U

1 - Reported as the ion

2 - 0.45 um silver metal filter

U - Not detected

Table 6. Conventional and Physical Test Results

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel[1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
Surface Samples									
MWSS016R1	13.8	32	25.3	24.2	38.6	11.9	50.5	55	3.34
MWSS017R1	7.9	7	3	27.9	56.5	12.7	69.2	42	2.7
MWSS018R1	7.7	180	18.2	41.7	29.7	10.4	40.1	53	5.89
MWSS019R1	9.9	230	8.6	52.7	30.9	7.9	38.7	47	3.42
MWSS020R1	6.7	73	2.6	53.2	36.4	7.8	44.2	69	0.949
MWSS021R1	13.8	53	1.1	39.1	46.6	13.2	59.8	48	2.66
MWSS022R1	1.3	167	59.8	21.5	14	4.7	18.7	60	4.35
MWSS023R1	7.8	14	0	68	27.2	4.8	32	66	1.66
MWSS024R1	14	723	9	38.1	38.2	14.7	53	42	4.42
MWSS025R1	12	49.5	1.7	38.3	41.6	18.4	60	50	3.03
MWSS026S1	11.8	80.1						64	3.08
MWSS026R1	6.1	148	19.7	33.6	35.3	11.4	46.7	62	2.44
MWSS027R1	8.8	517	1.5	40.2	41.4	16.9	58.3	48	3.32
MWSS028R1	2	162	45.3	27.5	22.1	5.1	27.2	70	1.26
MWSS029R1	14.5	962	1.8	33.5	47.6	17.2	64.7	48	3.02
MWSS030R1	13.4	1080	3	30	50.1	16.9	67	46	3.61

Table 6. Conventional and Physical Test Results (Continued)

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel[1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
MWSS031R1	20.2	302	3.1	53.9	29.9	13.2	43	40	6.34
MWSS032R1	12.6	1180	3.5	66.8	21.8	7.9	29.7	64	2.4
MWSS034R1	23.4	667	0.5	30.8	52.2	16.4	68.7	55	2.95
MWSS035R1	20.8	279	4.4	56.5	30.9	8.2	39.1	54	2.71
MWSS037R1	15.1	178	2	36.3	51.7	10.1	61.7	49	4.98
MWST039R1	10.1	13	2.6	57.1	32.2	8.1	40.3	66	2.98
MWST040S1	4.5	4						56	1.71
MWST040R1	4.2	5	0	58.1	37.1	4.8	41.9	65	1.44
MWSS040R1	6.2	0.5 UND	0.1	61.8	34	4.1	38.1	66	
MWST042R1	6.6	224	1.5	56.7	32.6	9.1	41.7	55	6.17
MWST043R1	8.4	6	0.2	48	44	7.8	51.8	62	2.26
MWST044R1	9	39	4.5	33.6	48.3	13.6	61.9	41	5.5
MWST045R1	12.3	211	1.6	46.3	42.5	9.6	52.1	51	5.27
MWST047R1	8	620	5.3	31.3	51.1	12.3	63.4	38	5.23
MWST048R1	9.5	37	0.3	36	55	8.8	63.8	55	2.79
MWST049R1	3.5	252	0.9	70.1	23.3	5.6	29	63	1.65
MWST051R1	14	56	5.3	30.3	51.2	13.2	64.4	50	7.82

Table 6. Conventional and Physical Test Results (Continued)

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel[1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
MWST052R1	10.3	190	0.4	46.2	44.3	9.1	53.4	55	3.32
MWST054R1	6.5	275	11.2	30.7	41.9	16.2	58	40	13
MWSS055R1	10.8	694	0.1	30	51.6	18.2	69.9	47	3.39

Table 6. Conventional and Physical Test Results (Continued)

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel[1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
Subsurface Samples									
MWCS024R2A	20.2	12.2	1.5	43.7	46.2	8.6	54.8	68	5.08
MWCS024R3A	12.2	5.2	0.1	55.2	40.6	4	44.7	74	0.833
MWCS025R2A	13.9	792	5.5	45.4	39.1	10	49	63	3.79
MWCS025R3A	19.9	54.3	0.2	87.1	10	2.7	12.7	80	0.325
MWCS025R4A	21.1	51.7	0.9	78.1	17	4	21	80	0.512
MWCS026R2A	15.9	174	0.1	13.1	70.8	16.1	86.9	67	0.977
MWCS026R3A	9.8	260	0	43.8	50.1	6.1	56.2	74	0.425
MWCS026R4A	19.1	186	0.3	39.1	50.2	10.4	60.6	75	0.395
MWCS027R2A	121	181	21	34.8	30.1	14.1	44.2	54	5.95
MWCS027R3A	74.6	257	0.1	17	69.1	13.8	82.9	70	1.43
MWCS027R4A	65.1	120	0	37.6	55.1	7.4	62.4	72	0.65
MWCS028R4A	13.1	93.5	0.1	30.1	58.7	11.2	69.8	73	1.41
MWCS028R2A	0.3	49.6	0.8	77.6	18.7	2.9	21.6	76	1.47
MWCS028R3A	1.2	38.1	1.3	88.2	8.5	2	10.5	78	0.753
MWCS029R2A	35.7	32.1	0	73.9	23.4	2.7	26.1	74	0.361
MWCS029R3A	28.7	67.1	0	49	44.5	6.5	51	77	0.376

Table 6. Conventional and Physical Test Results (Continued)

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel [1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
MWCS029R4A	30.2	36.3	0	67.1	28.5	4.4	32.9	75	0.453
MWCS030R2A	109	657	3.6	16.1	59.7	20.6	80.3	57	3.26
MWCS030R3A	8.1	54.4	0.3	76.4	20.1	3.3	23.4	81	6.03
MWCS030S2A	99.2	620	9.4	16.4	56	18.3	74.3	63	2.96
MWCS031R2A	31.1	727	14.6	54.1	23.6	7.8	31.3	64	5.86
MWCS031R3A	51.7	113	1.5	46.2	40.9	11.4	52.3	66	3.39
MWCS031R4A	24.7	2.6	0.6	85.6	11.6	2.2	13.8	82	0.492
MWCS034R3A	1.3	33	0.1	50.3	44.2	5.4	49.6	77	0.449
MWCS034R4A	7.6	57.2	0.1	67.1	29.2	3.7	32.8	72	0.911
MWCS034R2A	1.5	30.2	2.7	52.9	36.9	7.4	44.4	73	1.69
MWCS035R3A	5.6	54.3	0	34.4	58	7.6	65.6	73	0.666
MWCS035R4A	24.2	46.2	0	47.1	48.1	4.8	52.9	73	0.575
MWCS035S4A	23.5	69.4	0	39.2	55.4	5.4	60.8	75	0.575
MWCS035R2A	0.8	70.7	2	67	25.4	5.5	31	76	1.5
MWCS037R2A	5.7	69	3	86.7	8.2	2.2	10.3	77	2.92
MWCS037R3A	45.6	6.4	0.1	68.1	26.1	5.7	31.8	79	0.321
MWCS037R4A	47.6	4.1	0	65.8	29.4	4.8	34.2	72	0.421

Table 6. Conventional and Physical Test Results (Continued)

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel [1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
MWCS040R2A	2.8	1.8	1.8	56.6	36.4	5.3	41.6	75	3.92
MWCS040R3A	0.4	17.4	0.1	39.7	53.2	7	60.2	79	0.667
MWCS040R4A	1.5	19.9	0.7	88.1	9.1	2.2	11.3	86	0.285
MWCT041R2	10.1	626	1.3	47.1	42.5	9.1	51.6	55	4.24
MWCT046R2	4.5	34	0.5	47.5	37.9	14.1	52	52	3.67
MWCT050R2	13.2	826	1	34	52.3	12.6	64.9	61	4.53
MWCT053R2	5.3	83	1.8	15.7	72.1	10.5	82.6	58	2.66

Table 6. Conventional and Physical Test Results (Continued)

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel[1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
Bank Samples									
MWSB001R1	12.5	719	13.5	74.8	8.4	3.4	11.8	60	2
MWSB002R1	9.1	183	22.4	65.7	6.9	5	11.9	63	0.998
MWSB008R1	12.2	982	36.1	48.8	10.7	4.4	15.1	63	2.59
MWSB008S1	5.4	1230						50	1.57
MWSB008R1 SP	9.6	7.8	27.9	60.9	8.4	2.7	11.1	72	3.16
MWSB009R1	10	770	11	46	34.2	8.8	43	47	3.29
MWSB009R1 SP	14	663	3.7	32.1	52.7	11.4	64.1	44	3.6
MWSB012R1	2	2	14.6	65.8	15.1	4.5	19.6	62	4.86
MWSB013R1	1.7	70	46	48.6	3.3	2.1	5.4	76	0.519
MWSB014R1	6.7	3	54.7	41.5	3.1	0.6	3.7	71	1.7
MWSB015R1	9.3	41.6	5.9	78.4	12.2	3.5	15.7	52	1.49
MWSB015S1	17	114						70	1.8
MWSB03aR1	11.1	3.9	14.8	74.6	7	3.7	10.7	51	2.85
MWSB03bR1	11.8	135	5.2	76.1	14.6	4.2	18.8	57	3.12
MWSB04aR1	10.5	527	8.8	78.9	9.9	2.4	12.3	61	1.22
MWSB04bR1	13.2	344	5.9	73.2	16.1	4.8	20.9	64	3.5

Table 6. Conventional and Physical Test Results (Continued)

Sample Name	Ammonia as Nitrogen mg/kg	Total Sulfides mg/kg	Percent Gravel[1] %	Percent Sand %	Percent Silt %	Percent Clay %	Percent Fines %	Percent Solids %	Percent TOC %
MWSB04bR1 SP	4	223	6.1	87.7	4.2	2	6.2	76	2.69
MWSB10aR1	6.8	5	11	71.5	12.7	4.7	17.4	73	1.37
MWSB10bR1	6.7	6	38.7	43.9	11.9	5.5	17.4	68	1.72
MWSB10cR1	4.7	7	34.1	52.3	9.1	4.5	13.6	49	2.15
MWSB11aR1	6.6	4	24.5	69.8	4.1	1.6	5.7	51	0.847
MWSB11aR1 SP	3.6	119	23.7	71.6	3	1.7	4.7	57	1.72
MWSB11bR1	6.4	199	31.6	55.6	8.8	4.1	12.9	70	1.79

1 - "Percent Gravel" is a percent gravel-size material in the sample and may include wood or other debris.

D - Value was from an anlysis at a secondary dilution factor

N - Spiked sample recovery not within control limits

U - Value not detected

Table 7. Sediment Standards Biological Criteria

NO ADVERSE BIOLOGICAL CRITERIA	MINOR ADVERSE BIOLOGICAL CRITERIA
Sediments are determined to have adverse effects on biological resources when any one of the confirmatory marine sediment biological tests of WAC 173-204-315(1) demonstrates the following results: 1) Amphipod: The test sediment has a significantly higher[a] mean mortality than the reference sediment, and the test sediment mean mortality exceeds 25 percent, on an absolute basis. 2) Larval: The test sediment has a mean survivorship of normal larvae that is significantly less[a] than the mean normal survivorship in the reference sediment, and the test sediment mean normal survivorship is less than 85 percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than oe equal to 15 percent relative to time-final in the reference sediment). 3) *Juvenile polychaete: The test sediment has a* mean individual growth rate that is statistically different[a] from the reference sediment mean individual growth rate, and the test sediment has a mean individual growth rate of less than 70 percent of the reference sediment mean individual growth rate. 4) Benthic Infaunal Analysis – Major Benthic Taxa: Mean abundance of any one group < 50% of reference AND significantly ($P \leq 0.05$) *different.*	The minor adverse criteria is exceeded when any two of the biological tests exceed the no adverse biological criteria, or one of the following test determinations is made: 1) Amphipod: The test sediment has a significantly higher[a] mean mortality than the reference sediment, and the test sediment mean mortality is greater than a value represented by the reference sediment mean mortality plus thirty percent, on an absolute basis. 2) Larval: The test sediment has a mean survivorship of normal larvae that is significantly less[a] than the mean normal survivorship in the reference sediment, and the test sediment mean normal survivorship is less than 70 percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than or equal to 30 percent relative to time-final in the reference sediment). 3) Juvenile polychaete: The test sediment has a mean individual growth rate that is statistically different[a] from the reference sediment mean individual growth rate, and the test sediment has a mean individual growth rate of less than 50 percent of the reference sediment mean individual growth rate. 4) Benthic Infaunal Analysis – Major Benthic Taxa: Mean abundance of any two groups < 50% of reference AND significantly ($P \leq 0.05$) different.

NOTE: No Adverse – as defined in Table 24 of Work Plan
Minor Adverse – as defined in Table 25 of Work Plan

[a] Statistical significance is defined using a *t*-test, p= 0.05 for all test except the larval test, where p= 0.1.

Table 8. Comparison of Bioassay/Benthic Results and Sediment Biological Effects Interpretive Criteria

STATION ID	*R. abronius*		*Mytilus* sp.		*N. arenaceodentata*		Benthic Infaunal Abundance[a]		DESIGNATION
	NO ADVERSE	MINOR ADVERSE	NO ADVERSE	MINOR ADVERSE	NO ADVERSE	MINOR ADVERSE	NO ADVERSE	MINOR ADVERSE	
MW022	Pass	Pass	Pass	Pass	Pass	Pass			Pass
MW024	Pass	Pass	Pass	Pass	Pass	Pass			Pass
MW025	Pass	Pass	Pass	Pass	Fail	Pass			Minor Adverse
MW039	Pass	Pass	Pass	Pass			Fail	Pass	Minor Adverse
MW040	Pass	Pass	Pass	Pass	Pass	Pass			Pass
MW043	Pass	Pass	Pass	Pass			Pass	Pass	Pass
MW048	Pass	Pass	Pass	Pass			Pass	Pass	Pass
MW049	Pass	Pass	Pass	Pass			Fail[b]	Pass	Minor Adverse[b]
MW052	Pass	Pass	Pass	Pass			Pass	Pass	Pass
MW054	Pass	Pass	Pass	Pass			Pass[c]	Pass	Pass

NOTE: No Adverse – as defined in Table 24 of Work Plan
Minor Adverse – as defined in Table 25 of Work Plan

[a] Pollution-tolerant and opportunistic taxa are dominant in reference stations. Per Tables 24 and 25 of EPA-approved Work Plan, reference stations do not meet performance criteria. In addition, physical parameters (e.g., TOC) indicate that reference stations MW205 and MW207 are not appropriate (see June 24, 1998 memorandum on chronic biological testing). Therefore, all comparisons, except MW049, were made using MW206.

[b] Designation based on EPA direction to MWAC to use station MW205 to compare with MW049 even though the EPA-approved Work Plan decision criteria were not met at this location and MW049 had no SQO exceedances.

[c] Benthic threshold exceedance based on mollusc abundance set aside per discussions with EPA (November 11, 1998 meeting; EPA 1998 comment letter).

Table 9. Proposed Round 1B Sample Summary

																						Archive Strategy				
Station	Sample ID	Northing	Easting	Metals	Mercury	SVOCs[a]	Pentachlorophenol	PAHs	PCBs	Pesticides	Dioxin	Acute Bioassay Tests (Amphipod and Larval)	Neanthes Bioassay	Benthic Infauna	Grain Size	TOC	Percent Moisture	Total Sulfide, Ammonia	Density, Total Solids	QA/QC	Number of analyses	Archive	Archive (Yes or No)	Trigger[b]	Analyses[b]	Laboratory Priority Analyses
101	MWSB101R1	709759	1160411	Hg/Cu											1		1			1	4					–
102	MWSB102R1	709649	1160465	Hg/Cu											1		1				3					–
103	MWSB103R1	709538	1160514	Hg/Cu											1		1				3					–
104	MWSB104R1	709704	1160340	1											1		1				3					–
105	MWSS105R1	709760	1160443	Hg/Cu											1		1				3					
106	MWSS106R1	709737	1160561	Hg/Cu											1		1				3					
107	MWSS107R1	709884	1160523	Hg/Cu											1		1				3					Hg/Cu
108	MWSS108R1	709842	1160374	Hg/Cu											1		1				3					Hg/Cu
109	MWSS109R1	709838	1160311	1											1		1				3					–
110	MWSS110R1	709970	1160457	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 107 or 108	Hg and/or Cu	–
111	MWSS111R1	709304	1160719	1		1			1	1					1	1	1			1	8					
112	MWSS112R1	709274	1160817	1		1			1	1					1	1	1				7					
115	MWSS115R1	709019	1160815	1		1			1	1					1	1	1				7					–
117	MWSS117R1	708916	1160834	1		1			1	1					1	1	1				7					–
118	MWSB118R1	708654	1160938	1				1	1	1					1	1	1				7	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
119	MWSB119R1	708556	1160957	1				1	1	1					1	1	1				7	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
120	MWSB120R1	708466	1160983	1				1	1	1					1	1	1				7	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
121	MWSB121R1	708359	1161027	1				1	1	1					1	1	1				7	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
122	MWSB122R1	708266	1161052	1				1	1	1					1	1	1				7	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
123	MWSB123R1	708198	1161128	1				1	1	1					1	1	1				7	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
124	MWSB124R1	708095	1161143	1				1	1	1					1	1	1			1	8	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
125	MWSB125R1	707958	1161210	1				1	1	1					1	1	1				7	P; PP		<SQO for metals	PAHs, Pest/PCBs	Metals
126	MWSS126R1	708334	1161065	1				1							1	1	1				5					–
127	MWSS127R1	708518	1161017	1				1	1	1					1	1	1				7					–
128	MWSS128R1	708620	1161037	1				1							1	1	1				5	P		<SQO for metals	PAHs	Metals
129	MWSB129R1	708031	1161184		1			1							1	1	1				5					–
130	MWSB130R1	707837	1161258		1			1							1	1	1				5					–
131	MWSB131R1	707672	1161345		1			1							1	1	1				5					–
132	MWST132R1	707524	1161455		1	1			1	1	1				1	1	1				8	D		Conditional	dioxin	–
133	MWSB133R1	707565	1161411						1	1					1	1	1				5					–
134	MWSB134R1	707439	1161453						1	1					1	1	1			1	6					–
135	MWST135R1	707427	1161522		1	1			1	1	1				1	1	1				8	D		Conditional	dioxin	
136	MWST136R1	707551	1161606		1	1									1	1	1				5					
137	MWSS137R1	708756	1160955	1		1			1	1					1	1	1				7					–
138	MWST138R1	707350	1161620		1	1									1	1	1				5					
139	MWST139R1	707237	1161643		1	1									1	1	1				5					
140	MWST140R1	707274	1161531								1				1	1	1				4	D		Conditional	dioxin	–
141	MWST141R1	707104	1161680		1	1									1	1	1				5					
142	MWST142R1	707003	1161805	1		1			1						1	1	1				6					
144	MWST144R1	706918	1161911	1		1			1						1	1	1			1	7					–
145	MWSB145R1	708209	1161514				1		1						1	1	1				5	PCB	PCB	>PCB SQO @ 148	PCB	–

Table 9. Proposed Round 1B Sample Summary

																						Archive Strategy				
Station	Sample ID	Northing	Easting	Metals	Mercury	SVOCs[a]	Pentachlorophenol	PAHs	PCBs	Pesticides	Dioxin	Acute Bioassay Tests (Amphipod and Larval)	Neanthes Bioassay	Benthic Infauna	Grain Size	TOC	Percent Moisture	Total Sulfide, Ammonia	Density, Total Solids	QA/QC	Number of analyses	Archive	Archive (Yes or No)	Trigger[b]	Analyses[b]	Laboratory Priority Analyses
146	MWSB146R1	708325	1161471				1		1		1				1	1	1				6	PCB; D	PCB; D	>PCB SQO @ 148; Conditional	PCB; Dioxin	–
147	MWSB147R1	708448	1161431				1		1						1	1	1				5	PCB	PCB	>PCB SQO @ 148	PCB	–
148	MWSB148R1	708563	1161392				1	1	1	1					1	1	1				7					PP
149	MWSB149R1	708660	1161349				1	1	1	1					1	1	1				7					PP
150	MWSB150R1	708752	1161289				1	1	1	1					1	1	1				7					PP
153	MWST153R1	708193	1161220	1		1			1	1					1	1	1				7					All
154	MWST154R1	708304	1161396						1		1				1	1	1				5	A	All	>PCB SQO @ 148; Conditional	PCB; Dioxin	
156	MWST156R1	708731	1161230	1				1	1	1					1	1	1				7					
Count	49	Locations		22	9	14	6	18	29	23	5	0	0	0	49	39	49	0	0	5	276	17				
Subsurface Sample Locations																										
105	MWCS105R2	709760	1160443	Hg/Cu											1		1			1	4					Hg/Cu
105	MWCS105R3	709760	1160443	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 105R2	Hg and/or Cu	–
105	MWCS105R4	709760	1160443	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 105R2	Hg and/or Cu	–
106	MWCS106R2	709737	1160561	Hg/Cu											1		1				3					Hg/Cu
106	MWCS106R3	709737	1160561	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 106R2	Hg and/or Cu	–
106	MWCS108R4	709737	1160561	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 106R2	Hg and/or Cu	–
107	MWCS107R2	709884	1160523	Hg/Cu											1		1				3					Hg/Cu
107	MWCS107R3	709884	1160523	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 107R2	Hg and/or Cu	–
107	MWCS107R4	709884	1160523	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 107R2	Hg and/or Cu	–
108	MWCS108R2	709842	1160374	Hg/Cu											1		1				3					Hg/Cu
108	MWCS108R3	709842	1160374	Hg/Cu											1		1			1	4	A	Hg/Cu	>SQO @ 108R2	Hg and/or Cu	–
108	MWCS108R4	709842	1160374	Hg/Cu											1		1				3	A	Hg/Cu	>SQO @ 108R2	Hg and/or Cu	–
111	MWCS111R2	709304	1160719	1		1			1	1					1	1	1				7					All
111	MWCS111R3	709304	1160719	1		1			1	1					1	1	1				7	A	All	>SQO @ 111R2	Chemical groups >SQOs	–
111	MWCS111R4	709304	1160719	1		1			1	1					1	1	1				7	A	All	>SQO @ 111R2	Chemical groups >SQOs	–
112	MWCS112R2	709274	1160817	1		1			1	1					1	1	1				7					All
112	MWCS112R3	709274	1160817	1		1			1	1					1	1	1				7	A	All	>SQO @ 112R2	Chemical groups >SQOs	–
112	MWCS112R4	709274	1160817	1		1			1	1					1	1	1				7	A	All	>SQO @ 112R2	Chemical groups >SQOs	–
113	MWCS113R2	708988	1160864	1		1			1	1					1	1	1				7					All
113	MWCS113R3	708988	1160864	1		1			1	1					1	1	1				7	A	All	>SQO @ 113R2	Chemical groups >SQOs	–
113	MWCS113R4	708988	1160864	1		1			1	1					1	1	1			1	8	A	All	>SQO @ 113R2	Chemical groups >SQOs	–
114	MWCS114R2	708985	1160984	1		1			1	1					1	1	1				7					All

Table 9. Proposed Round 1B Sample Summary

																						Archive Strategy				
Station	Sample ID	Northing	Easting	Metals	Mercury	SVOCs[a]	Pentachlorophenol	PAHs	PCBs	Pesticides	Dioxin	Acute Bioassay Tests (Amphipod and Larval)	Neanthes Bioassay	Benthic Infauna	Grain Size	TOC	Percent Moisture	Total Sulfide, Ammonia	Density, Total Solids	QA/QC	Number of analyses	Archive	Archive (Yes or No)	Trigger[b]	Analyses[b]	Laboratory Priority Analyses
114	MWCS114R3	708985	1160984	1		1			1	1					1	1	1				7	A	All	>SQO @ 114R2	Chemical groups >SQOs	--
114	MWCS114R4	708985	1160984	1		1			1	1					1	1	1				7	A	All	>SQO @ 114R2	Chemical groups >SQOs	--
116	MWCS116R2	708957	1160801	1		1			1	1					1	1	1				7					All
116	MWCS116R3	708957	1160801	1		1			1	1					1	1	1				7	A	All	>SQO @ 116R2	Chemical groups >SQOs	
116	MWCS116R4	708957	1160801	1		1			1	1					1	1	1				7	A	All	>SQO @ 116R2	Chemical groups >SQOs	
126	MWCS126R2	708334	1161065	1				1							1	1	1				5					Metals
126	MWCS126R3	708334	1161065	1				1							1	1	1				5	M; P	All	<SQO @ 126R2	PAHs; Metals	--
126	MWCS126R4	708334	1161065	1				1							1	1	1				5	M; P	All	<SQO @ 126R2	PAHs; Metals	--
127	MWCS127R2	708518	1161017	1				1							1	1	1			1	6					Metals
127	MWCS127R3	708518	1161017	1				1							1	1	1				5	M; P	All	<SQO @ 127R2	PAHs; Metals	--
127	MWCS127R4	708518	1161017	1				1							1	1	1				5	M; P	All	<SQO @ 127R2	PAHs; Metals	--
135	MWCT135R2	707427	1161522		1	1			1	1					1	1	1				7					All
135	MWCT135R3	707427	1161522		1	1			1						1	1	1				6	A	All	>SQO @ 135R2	Chemical groups >SQOs	--
135	MWCT135R4	707427	1161522		1	1			1						1	1	1				6	A	All	>SQO @ 135R2	Chemical groups >SQOs	--
136	MWCT136R2	707551	1161606		1	1									1	1	1				5					All
136	MWCT136R3	707551	1161606		1	1									1	1	1				5	A	All	>SQO @ 136R2	Chemical groups >SQOs	--
136	MWCT136R4	707551	1161606		1	1									1	1	1				5	A	All	>SQO @ 136R2	Chemical groups >SQOs	--
137	MWCS137R2	708756	1160955	1		1			1	1					1	1	1				7					All
137	MWCS137R3	708756	1160955	1		1			1	1					1	1	1				7	A	All	>SQO @ 137R2	Chemical groups >SQOs	--
137	MWCS137R4	708756	1160955	1		1			1	1					1	1	1				7	A	All	>SQO @ 137R2	Chemical groups >SQOs	--
138	MWCT138R2	707350	1161620		1	1									1	1	1				5					All
138	MWCT138R3	707350	1161620		1	1									1	1	1			1	6	A	All	>SQO @ 138R2	Chemical groups >SQOs	--
138	MWCT138R4	707350	1161620		1	1									1	1	1				5	A	All	>SQO @ 138R2	Chemical groups >SQOs	--
139	MWCT139R2	707237	1161643		1	1									1	1	1				5					All
139	MWCT139R3	707237	1161643		1	1									1	1	1				5	A	All	>SQO @ 139R2	Chemical groups >SQOs	--
139	MWCT139R4	707237	1161643		1	1									1	1	1				5	A	All	>SQO @ 139R2	Chemical groups >SQOs	--
141	MWCT141R2	707104	1161680		1	1									1	1	1				5					All

Table 9. Proposed Round 1B Sample Summary

																						Archive Strategy				
Station	Sample ID	Northing	Easting	Metals	Mercury	SVOCs[a]	Pentachlorophenol	PAHs	PCBs	Pesticides	Dioxin	Acute Bioassay Tests (Amphipod and Larval)	Neanthes Bioassay	Benthic Infauna	Grain Size	TOC	Percent Moisture	Total Sulfide, Ammonia	Density, Total Solids	QA/QC	Number of analyses	Archive	Archive (Yes or No)	Trigger[b]	Analyses[b]	Laboratory Priority Analyses
141	MWCT141R3	707104	1161680		1	1									1	1	1				5	A	All	>SQO @ 141R2	Chemical groups >SQOs	–
141	MWCT141R4	707104	1161680		1	1									1	1	1				5	A	All	>SQO @ 141R2	Chemical groups >SQOs	–
142	MWCT142R2	707003	1161805	1		1			1						1	1	1				6					All
142	MWCT142R3	707003	1161805	1		1			1						1	1	1				6	A	All	>SQO @ 142R2	Chemical groups >SQOs	–
142	MWCT142R4	707003	1161805	1		1			1						1	1	1				6	A	All	>SQO @ 142R2	Chemical groups >SQOs	–
143	MWCT143R2	706909	1161760	1		1			1						1	1	1				6					–
143	MWCT143R3	706909	1161760	1		1			1						1	1	1			1	7					–
143	MWCT143R4	706909	1161760	1		1			1						1	1	1				6					–
144	MWCT144R2	706918	1161911	1		1			1						1	1	1				6					–
144	MWCT144R3	706918	1161911	1		1			1						1	1	1				6					All
144	MWCT144R4	706918	1161911	1		1			1						1	1	1				6	A	All	>SQO @ 144R3	Chemical groups >SQOs	All
151	MWCS151R2	709488	1160947	1		1			1	1					1	1	1				7					
151	MWCS151R3	709488	1160947	1		1			1	1					1	1	1				7					All
151	MWCS151R4	709488	1160947	1		1			1	1					1	1	1				7	A	All	>SQO @ 151R2	Chemical groups >SQOs	–
152	MWCS152R2	709462	1160835	1		1			1	1					1	1	1			1	8					
152	MWCS152R3	709462	1160835	1		1			1	1					1	1	1				7					All
152	MWCS152R4	709462	1160835	1		1			1	1					1	1	1				7	A	All	>SQO @ 152R2	Chemical groups >SQOs	–
153	MWCT153R2	708193	1161220	1		1			1	1					1	1	1				7	A	All	>SQO @ 153R1	Chemical groups >SQOs	–
153	MWCT153R3	708193	1161220	1		1			1	1					1	1	1				7	A	All			–
153	MWCT153R4	708193	1161220	1		1			1	1					1	1	1				7	A	All			–
155	MWCS155R2	709010	1160755	1		1			1	1					1	1	1				7					All
155	MWCS155R3	709010	1160755	1		1			1	1					1	1	1				7	A	All	>SQO @ 155R2	Chemical groups >SQOs	–
155	MWCS155R4	709010	1160755	1		1			1	1					1	1	1				7	A	All	>SQO @ 155R2	Chemical groups >SQOs	–
156	MWCT156R2	708731	1161230	1				1	1	1					1	1	1				7					All
156	MWCT156R3	708731	1161230	1				1	1	1					1	1	1			1	8	A	All	>SQO @ 156R2	Chemical groups >SQOs	–
156	MWCT156R4	708731	1161230	1				1	1	1					1	1	1				7	A	All	>SQO @ 156R2	Chemical groups >SQOs	–
157	*MWCS157R2*	*709138*	*1160969*	*1*		*1*			*1*	*1*					1	1	1				7					All
157	MWCS157R3	709138	1160969	1		1			1	1					1	1	1				7	A	All	>SQO @ 157R2	Chemical groups >SQOs	–

Table 9. Proposed Round 1B Sample Summary

																						Archive Strategy				
Station	Sample ID	Northing	Easting	Metals	Mercury	SVOCs[a]	Pentachlorophenol	PAHs	PCBs	Pesticides	Dioxin	Acute Bioassay Tests (Amphipod and Larval)	Neanthes Bioassay	Benthic Infauna	Grain Size	TOC	Percent Moisture	Total Sulfide, Ammonia	Density, Total Solids	QA/QC	Number of analyses	Archive	Archive (Yes or No)	Trigger[b]	Analyses[b]	Laboratory Priority Analyses
157	MWCS157R4	709138	1160969	1		1			1	1					1	1	1				7	A	All	>SQO @ 157R2	Chemical groups >SQOs	–
Count	26	Locations		51	15	57	0	9	48	37	0	0	0	0	78	66	78	0	0	8	459	48	48			
Biological Sample Locations																										
34	MWAS034R1	708926	1161088									1	1		1	1		1			5					–
37	MWAS037R1	708663	1161106									1	1		1	1		1			5					–
41	MWAT041R1	708305	1161277									1		1	1	1		1			5					–
42	MWAT042R1	708195	1161410									1	1		1	1		1			5					–
44	MWAT044R1	707996	1161264									1	1		1	1		1			5					–
45	MWAT045R1	707950	1161528									1	1		1	1		1			5					–
46	MWAT046R1	707839	1161472									1	1		1	1		1			5					–
47	MWAT047R1	707776	1161314									1	1		1	1		1			5					–
153	MWAT153R1	708193	1161220									1		1	1	1		1			5					
209	MWRC209R1	736775	1101496									1	1		1	1		1			5					
206	MWRH206R1	715548	1169887											1	1	1		1			4					
Count	11	Locations		0	0	0	0	0	0		0	10	8	3	11	11	0	11	0	0	54	0				
Natural Recovery Stations																										
158	MWCT158	708490	1161262		1														1							–
159	MWCT159	707804	1161387		1														1							–
Count	2	Locations		0	2	0	0	0	0			0	0	0	0	0	0	0	2	0		0				

A = Archive all chemical analyses listed for the sample.
P = SQO PAHs
PP = Pesticides/PCB
D = Dioxin
M = Metals

[a] = SVOC consists of the chemical groups: phenols, PAHs, chlorinated aromatics, chlorinated alphiatics, phthalates, and misc. extractable organics, as defined in Table 1.

[b] = If an archived sample is triggered for an analysis by an SQO exceecence, the chemical group associated with that compound will be analyzed unless otherwise indicated. Chemical groups are defined in Table 1.

Table 10. Analytical Results for the Contaminant Mobility Sediment Composite Sample

		Contaminant Mobility Bulk Chemistry				Predicted Middle Waterway Bulk Chemistry[d]		
Parameter	**Sediment Quality Objective**	**Middle Waterway Round 1A Contaminant Mobility Composite**	**Thea Foss Dredge Prism Composite[a]**	**Thea Foss SSMA 7 Composite[b]**	**Middle Waterway Tideflat "Hotspot" Bulk Chemistry[c]**	**Volume-Weighted Predicted Concentrations 5,000 cy**	**Volume-Weighted Predicted Concentrations 10,000 cy**	**Volume-Weighted Predicted Concentrations 15,000 cy**
TOC (%)		2.4	3	3 9	7.2	—	—	—
SVOCs (ug/kg)								
Benzo(a)anthracene	1600	1700	7067	20550	10116	2261	2822	3383
Benzo(a)pyrene	1600	1200	6733	17350	6871	1565	1930	2294
Benzo(g,h,i)perylene	720	680	2500	4250	2552	805	930	1054
Benzofluoranthenes	3600	2100	7687	21600	10607	2667	3234	3801
Chrysene	2800	2000	7267	21050	6597	2240	2480	2719
Dibenz(a,h)anthracene	230	210	610	1050	449	226	242	258
Fluoranthene	2500	5600	11200	37950	14007	6160	9721	7281
Indeno(1,2,3-cd)pyrene	690	610	2090	3565	2720	751	891	1032
Pyrene	3300	3900	16567	51600	57533	7476	11051	14627
Total HPAH	17000	18000	61690	178965	110043	24136	30272	36409
2-Methylnaphthalene	670	290	910	---	782	323	356	388
Acenaphthylene	1300	150	1380	1385	4309	427	704	982
Acenaphthene	500	1400	2700	50095	42443	4136	6872	9609
Anthracene	960	1900	7367	29800	8749	2357	2813	3270
Fluorene	540	2500	3133	29135	9400	2961	3421	3882
Naphthalene	2100	530	807	105180	15859	1552	2574	3596
Phenanthrene	1500	6300	20267	91050	32365	8038	9775	11513
Total LPAH	5200	13070	36563	361760	109833	19508	25945	32383
Phenolics (ug/kg)								
2,4-Dimethylphenol	29	20	19 U	---	28	21	21	22
2-Methylphenol	63	10	19 U	---	31	11	13	14
4-Methylphenol	670	99	97 U	---	216	107	115	122
Pentachlorophenol	360	7.7	193 U	---	128	16	24	32
Phenol	420	49	97 U	---	176	57	66	74
Phthalates (ug/kg)								
bis(2-Ethylhexyl)phthalate	1300	130	737 U	6900	794	174	219	263
Butylbenzylphthalate	900	60 U	104 U	425 UJ	139	65	70	76
Diethylphthalate	200	43 U	97 U	99 U	78	45	48	50
Dimethylphthalate	160	38 U	97 U	99 U	82	41	44	47
Di-n-butylphthalate	1400	40 U	97 U	114.5	89	43	47	50
Di-n-octylphthalate	6200	290 U	97 U	765	152	281	272	262
1,2,4-Trichlorobenzene	51	8 U	19 U	---	19	8	9	10
1,2-Dichlorobenzene	50	3 U	19 U	---	22	4	6	7
1,3-Dichlorobenzene	170	3 U	97 U	---	60.9 U	7	11	15
1,4-Dichlorobenzene	110	3.0 U	97 U	---	74	8	13	17
Benzoic acid	650	55	487 U	---	376	76	98	119
Benzyl alcohol	73	2.1	19 U	---	18	3	4	5
Dibenzofuran	540	780	750	---	1896	788	795	803
Hexachlorobenzene	22	3 U	.97 U	---	6.7 U	2.8	3.1	3.3
Hexachlorobutadiene	11	3 U	.97 U	---	7.9 U	2.9	3.2	3.6
N-Nitrosodiphenylamine	28	26 U	19 U	---	38	26.8	27.6	28.5
Metals (mg/kg)								
Antimony	150	3.9 U	---	---	4	3.9	4.0	4.0
Arsenic	57	13.2	10.9	39	16	13.4	13.5	13.7
Cadmium	5.1	0.4 U	1.8	9.3	2	0.47	0.55	0.63
Copper	390	138	70.2	363	149	138.7	139.4	140.1
Lead	450	106	126	886.5	265	117	127	138
Mercury	0.59	1.1	0.78	1.3	0.69	1.07	1.09	1.02
Nickel	140	10.6	20	140.8	19	11.1	11.7	12.2
Silver	6.1	0.8 U	2.8	14.1	0.97	0.79	0.81	0.82
Zinc	410	108	176.2	1081	199	114	120	126
Pesticides/PCBs (ug/kg)								
Total PCBs	300	34 J	61	480	137	41	48	55
4,4'-DDD	16	5.0 U	8.6 U	69	10.8 U	5.4	5.8	6.2
4,4'-DDE	9	5.0 U	3.9 U	29 U	10 8 U	5.4	5.8	6.2
4,4'-DDT	34	5.0 U	7.9 U	69.5 UJ	18 2 U	5.9	6.8	7.6
VOCs (ug/kg)								
Ethylbenzene	10	3.0 U	---	---	8.9 U	3.4	3.8	4.2
Tetrachloroethene	57	3.0 U	---	---	8.9 U	3.4	3.8	4.2
Xylenes (total)	40	3.0 U	---	---	10.0 U	3.5	3.9	4.4
Grain Size (%)								
Percent Gravel	--	2	1.3	0.4	3.1	2.1	2.1	2.2
Percent Sand	--	47	51.7	8.1	32.7	46.0	45.1	44.1
Percent Silt	--	42	38.7	69.5	51.2	42.6	43.2	43.8
Percent Clay	--	9	8.3	13.1	13.0	9.3	9.5	9.8
Percent Fines	--	51	47.0	82.5	70.5	52.3	53.6	54.9

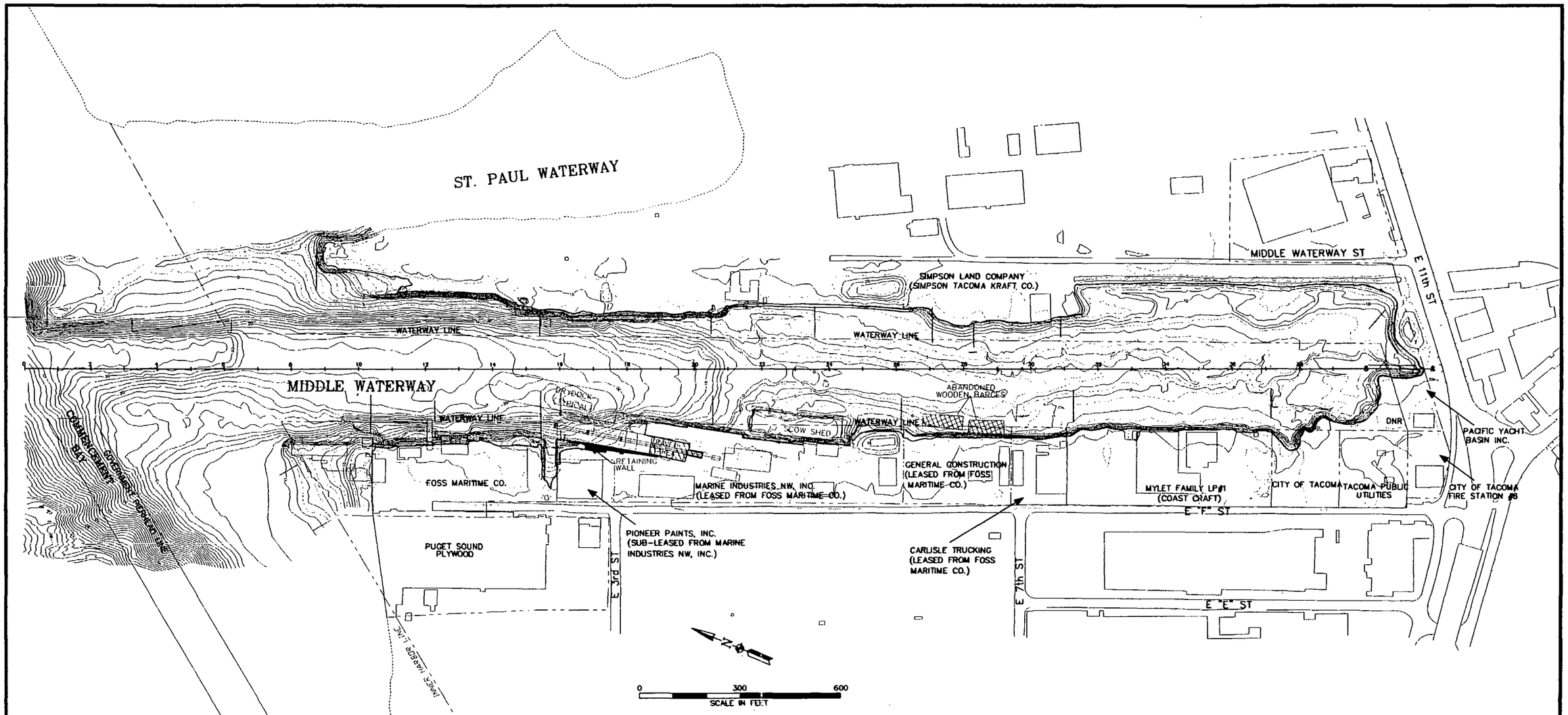
[a] Data from Table 6-2 of Thea Foss Round 3 report (HartCrowser 1998). These data are included to provide a comparison with the relatively large volume and similar chemical concentration of other CB/NT sediments that may be co-disposed with Middle Waterway sediments.

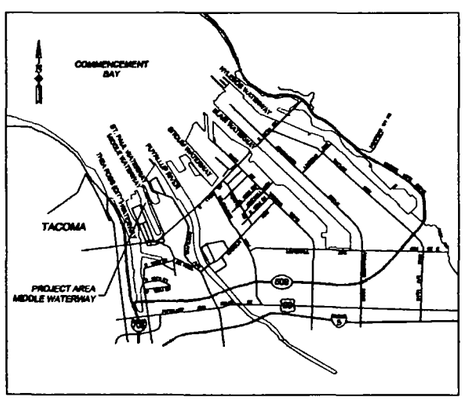
[b] Data calculated from Table 6-2 of Thea Foss Round 3 report (HartCrowser 1998). These data are included to provide a comparison with the relatively large volume and similar chemical concentration of other CB/NT sediments that may be co-disposed with Middle Waterway sediments

[c] In the absence of Round 1B data necessary to understand the spatial resolution of sediments that require removal, we have defined potential "hotspot" sediments based on the Round 1A and historical chemical data from the head of the Middle Waterway. Specifically, the representative chemical concentration of the potential "hotspot" sediments are based on the average chemical concentration from stations located with the potential "hotspot" area(s). Stations used in developing the average concentration for the potential hotspot area within the tideflats included stations from Round 1A and historical stations with any SQO exceedences: MW050, MW051, MW052, MW054, TF-21, TF-22, TF-23, HC-1, HC-3, MD-11. For chemicals that were not detected in a sample, the detection limit was used as the concentration and included in the calculation.

[d] In the absence of Round 1B data necessary to understand the spatial resolution of sediments that require removal, we have evaluated three (3) potential "hotspot" volumes (5000, 10,000, and 15,000 cubic yards). These preliminary volumes are based on an evaluation of Round 1A and historical chemical data and include the assumption that the sediments to be removed are based on hotspot removal with replacement of clean sediment back to the original elevation. Volume-weighted concentrations assume that a total of 75,000 cy is the total amount of sediments (including overdredge) potentially to be removed from the Middle Waterway and that the potential hotspot sediments will represent a portion of that volume. For example, the volume-weighted concentration for mercury in the 10,000 cy scenario is calculated by multiplying the bulk composite concentration by 65,000, adding that product to the average hotspot concentration and 10,000 cy, and then dividing by 75,000 cy (i.e., [(1.7*65,000)+(0.69*10,000)]/75,000 = 1.57).

FIGURES





NOTES:

1. **Horizontal Datum: WA State Plane South Zone (NAD 83-91)**
   Vertical Datum: COE Mean Lower Low Water

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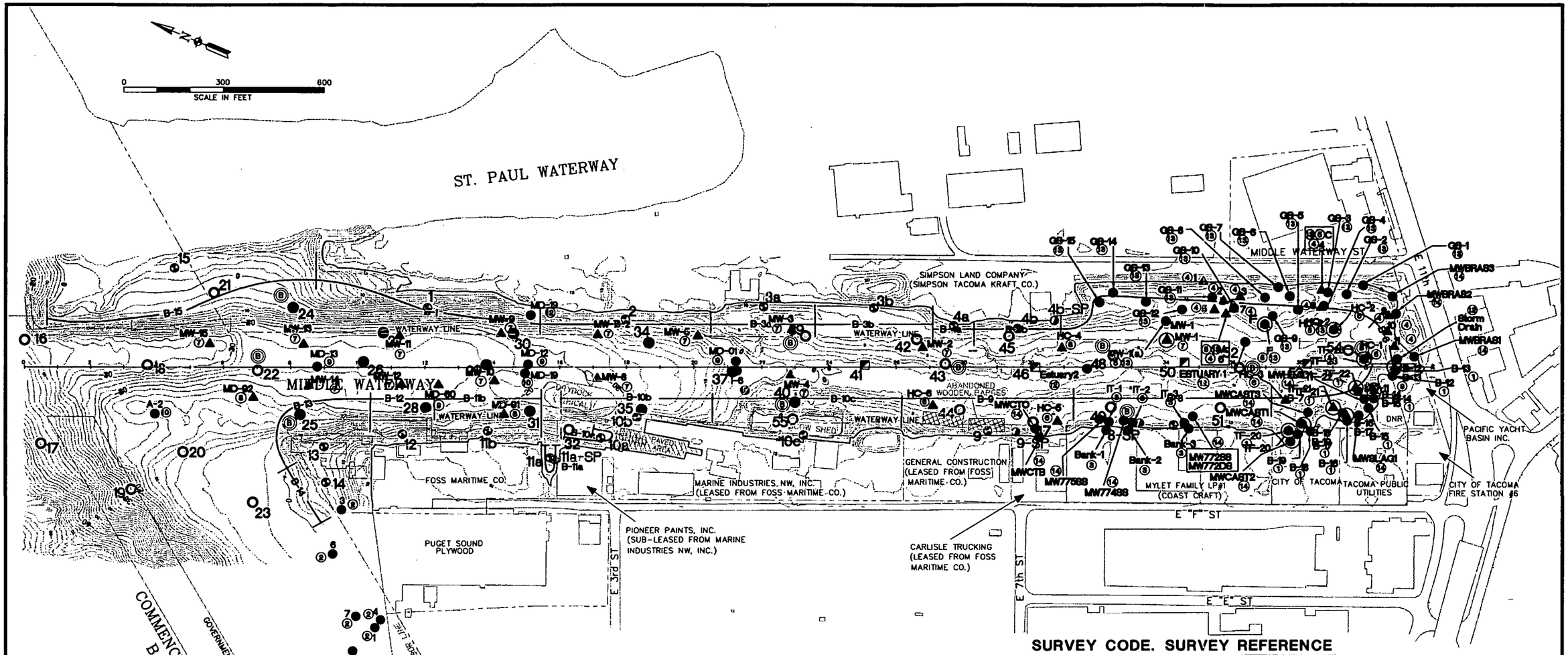
Figure 1
Middle Waterway Problem Area
Vicinity & Site Map

I:\PROJECTS\16990013\DWG\MMWWFG04-1.DWG
PLOT/UPDATE: August 12, 1999

MMWWFG04-1.DWG



LEGEND

- Surface Sediment Sample Location
- Surface Sediment and Co-located Subsurface Sediment Core Location
- Shallow (0-2 feet) Subsurface Sediment Sample Location (1 composite sample)
- —B-12— Waterway Bank Sections (B-3, B-10, and B-11 subsectioned)
- Representative Location of Composite Bank Sample
- Supplemental Sample Location
- Automatic Biological Testing Sample Locations
- Property Line (Including Leases)
- IT-1 ● Historical Surface Sample Area
- MW-14 ▲ Historical Core Sample Area
- ② Survey Code Reference

SURVEY CODE. SURVEY REFERENCE

1. City of Tacoma (1997b)
2. City of Tacoma (1996b)
3. Environmental Partners (1995)
4. Parametrix (1994a)
5. Parametrix (1993)
6. Hart Crowser (1992b)
7. Parametrix (1988), as cited in Weston (1997b)
8. FS/Tetra Tech (1988)
9. RI/Tetra Tech (1985)
10. Pre -RI Agency Surveys
11. Johnstone (1986) - (See Note 1 Below)
12. Johnstone (1985) - (See Note 1 Below)
13. Parametrix (1996)
14. Ecology (1993)

NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.
2. Horizontal Datum: WA state plane south zone (NAD83)
   Vertical Datum: COE mean lower low water
3. Samples not collected in bank segments B-5,B-6, or B-7.
4. The top of bank is approximately +15 MLLW

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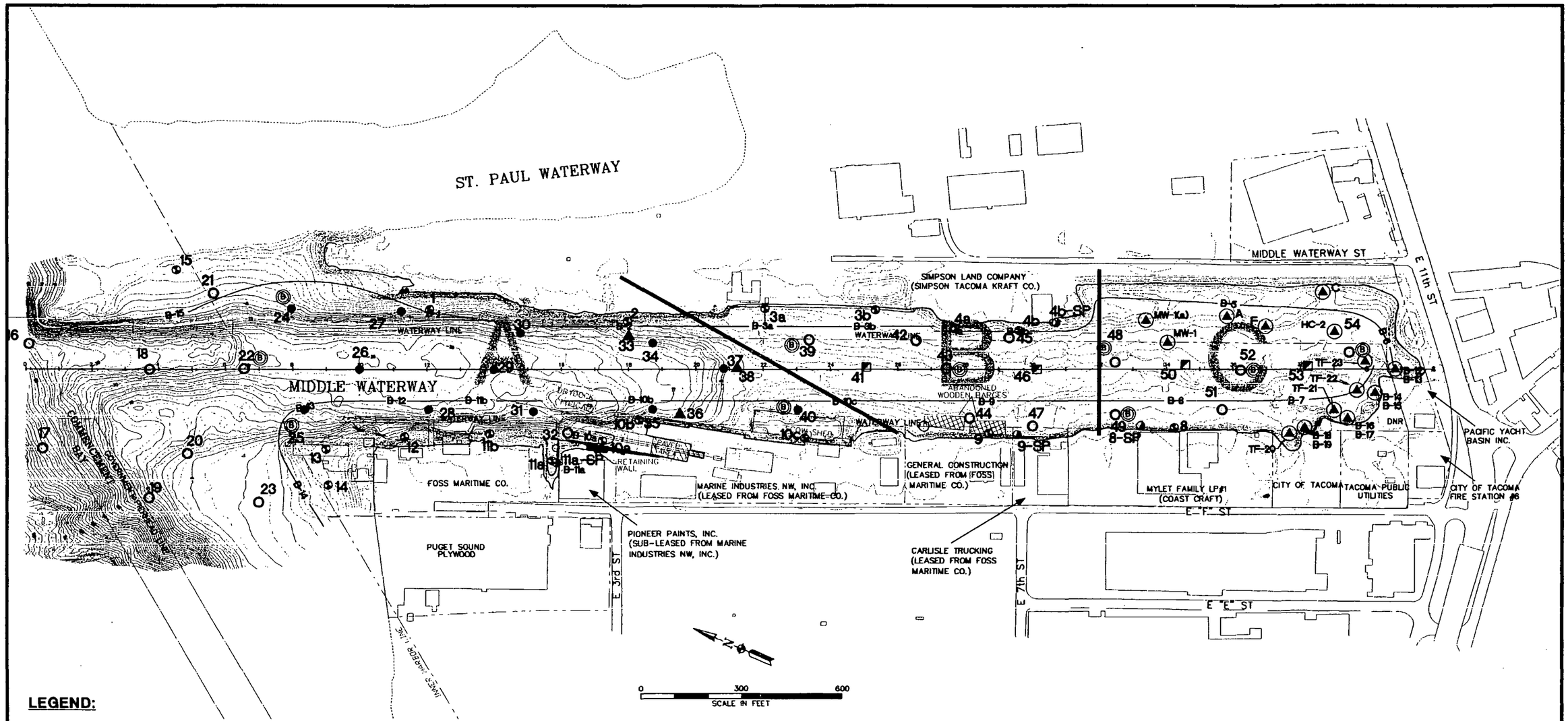
Figure 2
Middle Waterway Problem Area
Round 1A and
Historical Sample Stations

I:\PROJECTS\16990013\DWG\MMWWFG04A.DWG
PLOT/UPDATE: DEC 08 1998 13:36:21

MMWWFG04A.DWG



LEGEND:

- ○ SURFACE SEDIMENT SAMPLE LOCATION
- ● SURFACE SEDIMENT AND CO-LOCATED SUBSURFACE SEDIMENT CORE LOCATION
- ◩ SHALLOW (0-2 FEET) SUBSURFACE SEDIMENT SAMPLE LOCATION (1 COMPOSITE SAMPLE)
- B-10b WATERWAY BANK SECTIONS (B-3, B-10, AND B-11 SUBSECTIONED)
- ① REPRESENTATIVE LOCATION OF COMPOSITE BANK SAMPLE
- ◑ SUPPLEMENTAL SAMPLE LOCATION
- (B) AUTOMATIC BIOLOGICAL TESTING SAMPLE LOCATIONS
- ---------- PROPERTY LINE (INCLUDING LEASES)
- (▲) HISTORICAL STATIONS

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NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.
2. Horizontal Datum: WA State Plane South Zone (NAD 83-91)
   Vertical Datum: COE Mean Lower Low Water.
3. Samples not collected in bank segments B-5, B-6, or B-7.

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Figure 3
Middle Waterway Problem Area
Round 1A and Selected
Historical Sample Stations

I:\PROJECTS\16990013\DWG\MWWFG04-3.DWG
PLOT/UPDATE: August 13, 1999

MWWFG04-3.DWG

MW016	Surface
Fines	50. 50%
TOC	3. 34%

MW018	Surface
Fines	40. 00%
TOC	5. 89%
N-Nitrosodiphenylamine	1. 04

MW021	Surface
Fines	59. 80%
TOC	2. 66%
Mercury	1. 29

MW022	Surface
Biological Tests	Pass
Fines	18. 70%
TOC	4. 35%
Copper	1. 63
Mercury	3. 73
N-Nitrosodiphenylamine	1. 64

MW024	Surface
Biological Tests	Pass
Fines	53. 00%
TOC	4. 42%
Anthracene	1. 04
Fluoranthene	1. 72
Pyrene	1. 06

MW027	Surface
Fines	58. 30%
TOC	3. 32%
Mercury	1. 51

MW032	Surface
Fines	29. 70%
TOC	2. 40%
Arsenic	1. 71
Benzoic acid	2. 00
Copper	2. 82
Mercury	7. 97
Zinc	1. 26

MW034	Surface
Fines	68. 70%
TOC	2. 95%
Mercury	1. 25
Phenol	1. 48

MW035	Surface
Fines	39. 10%
TOC	2. 71%
Mercury	1. 86
N-nitrosodiphenylamine	1. 14U

MW037	Surface
Fines	61. 70%
TOC	4. 98%
Mercury	2. 37
N-Nitrosodiphenylamine	2. 36

MW039	Surface
Biolog. Tests - Minor	Adverse
Fines	40. 30%
TOC	2. 98%
Acenaphthene	2. 40
Anthracene	1. 77
Benzo(a)anthracene	1. 13
Benzo(g, h, i)perylene	1. 38
Benzofluoranthenes	1. 33
Dibenzofuran	2. 22
Fluoranthene	3. 12
Fluorene	2. 78
Indeno(1, 2, 3-cd)pyrene	1. 07
Phenanthrene	2. 13
Pyrene	1. 48
Total LPAH	1. 97
Total HPAH	1. 44

MW045	Surface
Fines	52. 10%
TOC	5. 27%
Mercury	1. 44

MW052	Surface
Biological Tests	Pass
Fines	53. 40%
TOC	3. 32%
N-Nitrosodiphenylamine	2. 96

MW048	Surface
Biological Tests	Pass
Fines	63. 80%
TOC	2. 79%
Acenaphthene	2. 20
Benzo(a)pyrene	1. 06
Benzo(g, h, i)perylene	1. 04
Benzofluoranthenes	1. 33
Fluoranthene	1. 28
Fluorene	1. 56
Naphthalene	1. 33
Phenanthrene	1. 67
Pyrene	1. 09
Total LPAH	1. 73
Total HPAH	1. 07

MW054	Surface
Biological Tests	Pass
Fines	58. 00%
TOC	13. 00%
2, 4-Dimethylphenol	1. 86
2-Methylnaphthalene	1. 36
Acenaphthene	1. 16
Anthracene	1. 56
Benzo(a)anthracene	1. 13
Benzofluoranthenes	1. 56
Dibenzofuran	1. 07
Fluoranthene	1. 76
Fluorene	2. 04
Indeno(1, 2, 3-cd)pyrene	1. 74
Mercury	1. 41
Naphthalene	2. 00
Phenanthrene	2. 73
Pyrene	1. 52
Total LPAH	2. 52
Total HPAH	1. 21

TF-20	Surface
Fines	73. 00%
TOC	4. 33%
1, 2-Dichlorobenzene	1. 98U

MW025	Surface
Biological	Minor Adverse
Fines	60. 00%
TOC	3. 03%
Mercury	10. 00

MW017	Surface
Fines	69. 20%
TOC	2. 70%

MW019	Surface
Fines	38. 70%
TOC	3. 42%

MW020	Surface
Fines	44. 20%
TOC	0. 95%

MW023	Surface
Fines	32. 00%
TOC	1. 66%

MW026	Surface
Fines	46. 70%
TOC	2. 44%
Arsenic	1. 23
Zinc	1. 03

MW028	Surface
Fines	27. 20%
TOC	1. 26%
Fluorene	1. 02

MW029	Surface
Fines	64. 70%
TOC	3. 02%
Mercury	2. 03

MW030	Surface
Fines	67. 00%
TOC	3. 61%
Mercury	3. 39

MW040	Surface
Biological Tests	Pass
Fines	41. 90%
TOC	1. 44%

MW055	Surface
Fines	69. 90%
TOC	3. 39%
Copper	1. 03
Mercury	4. 92

MW031	Surface
Fines	43. 00%
TOC	6. 34%
4, 4-DDE	10. 33
Acenaphthene	1. 32
Anthracene	1. 04
Benzo(a)anthracene	1. 25
Butylbenzylphthalate	1. 11U
Benzofluoranthenes	2. 17
Chrysene	1. 04
Fluoranthene	2. 76
Fluorene	1. 31
Mercury	1. 56
N-nitrosodiphenylamine	1. 54U
PCB (total)	4. 33
Phenanthrene	2. 47
Pyrene	1. 79
Total LPAH	1. 40
Total HPAH	1. 67

MW042	Surface
Fines	41. 80%
TOC	6. 17%
Mercury	1. 69

MW043	Surface
Biological Tests	Pass
Fines	51. 80%
TOC	2. 26%

MW044	Surface
Fines	61. 90%
TOC	5. 50%
Mercury	4. 41

MW047	Surface
Fines	63. 40%
TOC	5. 23%
4-Methylphenol	1. 03
Mercury	2. 88

MW049	Surface
Biological Tests	Pass
Fines	29. 00%
TOC	1. 65%

MW051	Surface
Fines	64. 40%
TOC	7. 82%
2, 4-Dimethylphenol	3. 45
2-Methylnaphthalene	2. 09
2-Methylphenol	1. 22
Acenaphthene	9. 20
Acenaphthylene	1. 23
Anthracene	2. 71
Benzo(a)anthracene	3. 94
Benzo(a)pyrene	4. 00
Benzo(g, h, i)perylene	5. 28
Benzofluoranthenes	6. 67
Chrysene	2. 29
Dibenzofuran	5. 37
Fluoranthene	5. 20
Fluorene	7. 04
Indeno(1, 2, 3-cd)pyrene	4. 93
Mercury	1. 56
N-Nitrosodiphenylamine	6. 79
Naphthalene	2. 52
Phenanthrene	8. 67
Pyrene	4. 55
Total LPAH	6. 21
Total HPAH	4. 61

TF-21	Surface
Fines	75. 00%
TOC	5. 13%
Mercury	1. 39
Bis(2-ethylhexyl)phthalate	1. 23

TF-22	Surface
Fines	91. 00%
TOC	6. 12%
Bis(2-ethylhexyl)phthalate	2. 69
Dibenzo(a, h)anthracene	2. 83
Benzo(g, h, i)perylene	2. 64
Indeno(1, 2, 3-cd)pyrene	2. 32
Benzo(a)pyrene	2. 19
Benzofluoranthenes	1. 97
Benzo(a)anthracene	1. 94
Total HPAHs	1. 77
Chrysene	1. 68
Fluoranthene	1. 64
Phenanthrene	1. 47
Mercury	1. 17
Pyrene	1. 03

TF-23	Surface
Fines	78. 00%
TOC	10. 28%
Mercury	3. 83
PCB (Total)	1. 60
Benzo(g, h, i)perylene	1. 04
Copper	1. 02
4, 4-DDT	1. 18U

0 300 600
SCALE IN FEET

LEGEND

- O Surface Sediment Sample Location
- Historical Stations
- Property Line (Including Leases)
- Top of Bank

Station	Depth
Percent Fines	%
Percent TOC	%
Chemical Exceedence	Factor

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Figure 4
Middle Waterway Problem Area
Round 1A Surface Samples
And Exceedence Factors

I:\PROJECTS\16990013\DWG\WR1AFG11.DWG
PLOT/UPDATE: APR 05 1999 10:21:51

mr1afg11.DWG

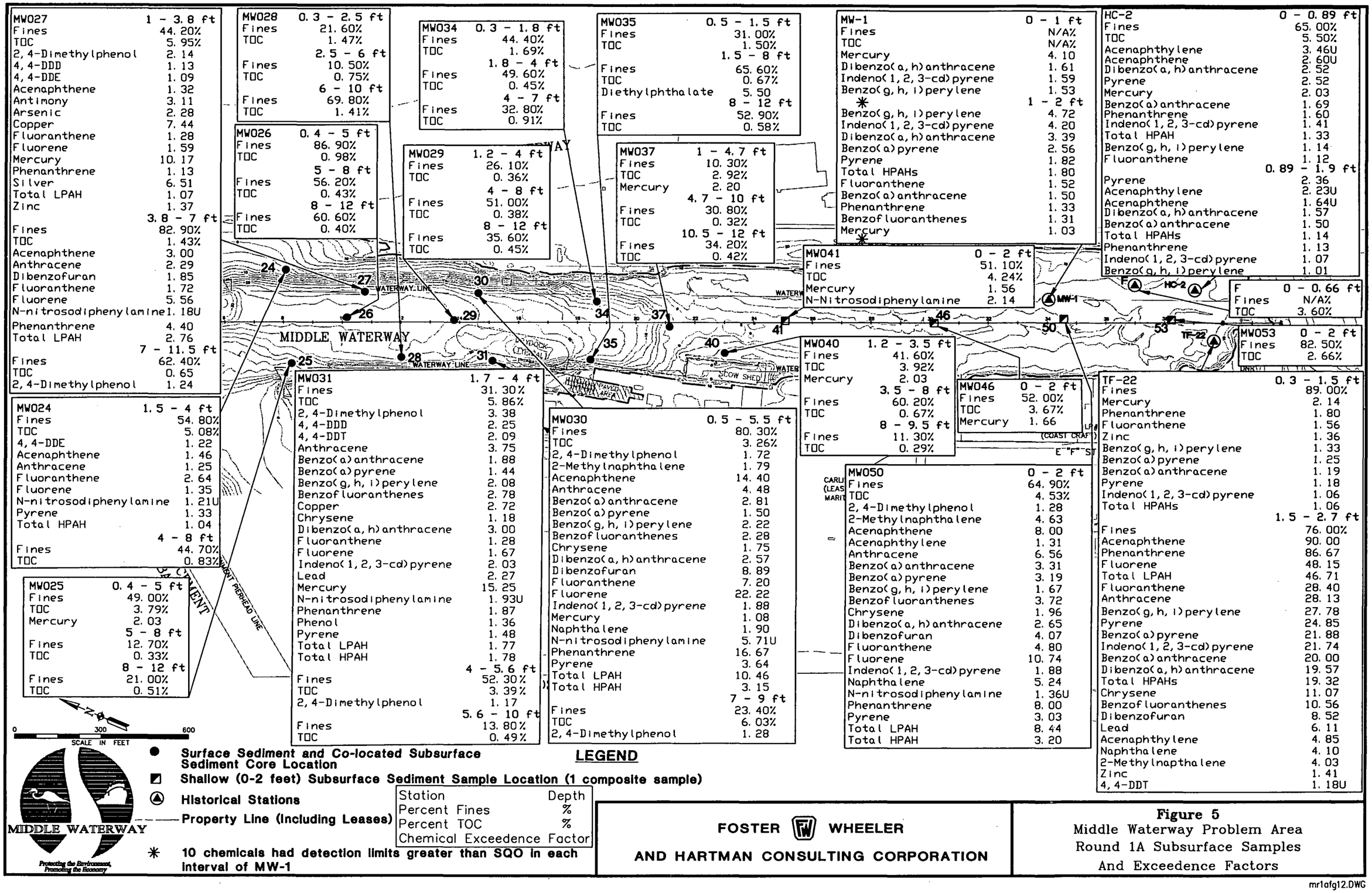
MW027 1 - 3.8 ft
Fines 44.20%
TOC 5.95%
2,4-Dimethylphenol 2.14
4,4-DDD 1.13
4,4-DDE 1.09
Acenaphthene 1.32
Antimony 3.11
Arsenic 2.28
Copper 7.44
Fluoranthene 1.28
Fluorene 1.59
Mercury 10.17
Phenanthrene 1.13
Silver 6.51
Total LPAH 1.07
Zinc 1.37
3.8 - 7 ft
Fines 82.90%
TOC 1.43%
Acenaphthene 3.00
Anthracene 2.29
Dibenzofuran 1.85
Fluoranthene 1.72
Fluorene 5.56
N-nitrosodiphenylamine 1.18U
Phenanthrene 4.40
Total LPAH 2.76
7 - 11.5 ft
Fines 62.40%
TOC 0.65
2,4-Dimethylphenol 1.24
MW028 0.3 - 2.5 ft
Fines 21.60%
TOC 1.47%
2.5 - 6 ft
Fines 10.50%
TOC 0.75%
6 - 10 ft
Fines 69.80%
TOC 1.41%
MW034 0.3 - 1.8 ft
Fines 44.40%
TOC 1.69%
1.8 - 4 ft
Fines 49.60%
TOC 0.45%
4 - 7 ft
Fines 32.80%
TOC 0.91%
MW035 0.5 - 1.5 ft
Fines 31.00%
TOC 1.50%
1.5 - 8 ft
Fines 65.60%
TOC 0.67%
Diethylphthalate 5.50
8 - 12 ft
Fines 52.90%
TOC 0.58%
MW-1 0 - 1 ft
Fines N/A%
TOC N/A%
Mercury 4.10
Dibenzo(a,h)anthracene 1.61
Indeno(1,2,3-cd)pyrene 1.59
Benzo(g,h,i)perylene 1.53
* 1 - 2 ft
Benzo(g,h,i)perylene 4.72
Indeno(1,2,3-cd)pyrene 4.20
Dibenzo(a,h)anthracene 3.39
Benzo(a)pyrene 2.56
Pyrene 1.82
Total HPAHs 1.80
Fluoranthene 1.52
Benzo(a)anthracene 1.50
Phenanthrene 1.33
Benzofluoranthenes 1.31
Mercury 1.03
HC-2 0 - 0.89 ft
Fines 65.00%
TOC 5.50%
Acenaphthylene 3.46U
Acenaphthene 2.60U
Dibenzo(a,h)anthracene 2.52
Pyrene 2.52
Mercury 2.03
Benzo(a)anthracene 1.69
Phenanthrene 1.60
Indeno(1,2,3-cd)pyrene 1.41
Total HPAH 1.33
Benzo(g,h,i)perylene 1.14
Fluoranthene 1.12
0.89 - 1.9 ft
Pyrene 2.36
Acenaphthylene 2.23U
Acenaphthene 1.64U
Dibenzo(a,h)anthracene 1.57
Benzo(a)anthracene 1.50
Total HPAHs 1.14
Phenanthrene 1.13
Indeno(1,2,3-cd)pyrene 1.07
Benzo(g,h,i)perylene 1.01
MW026 0.4 - 5 ft
Fines 86.90%
TOC 0.98%
5 - 8 ft
Fines 56.20%
TOC 0.43%
8 - 12 ft
Fines 60.60%
TOC 0.40%
MW029 1.2 - 4 ft
Fines 26.10%
TOC 0.36%
4 - 8 ft
Fines 51.00%
TOC 0.38%
8 - 12 ft
Fines 35.60%
TOC 0.45%
MW037 1 - 4.7 ft
Fines 10.30%
TOC 2.92%
Mercury 2.20
4.7 - 10 ft
Fines 30.80%
TOC 0.32%
10.5 - 12 ft
Fines 34.20%
TOC 0.42%
MW041 0 - 2 ft
Fines 51.10%
TOC 4.24%
Mercury 1.56
N-Nitrosodiphenylamine 2.14
F 0 - 0.66 ft
Fines N/A%
TOC 3.60%
MW053 0 - 2 ft
Fines 82.50%
TOC 2.66%
MW024 1.5 - 4 ft
Fines 54.80%
TOC 5.08%
4,4-DDE 1.22
Acenaphthene 1.46
Anthracene 1.25
Fluoranthene 2.64
Fluorene 1.35
N-nitrosodiphenylamine 1.21U
Pyrene 1.33
Total HPAH 1.04
4 - 8 ft
Fines 44.70%
TOC 0.83%
MW031 1.7 - 4 ft
Fines 31.30%
TOC 5.86%
2,4-Dimethylphenol 3.38
4,4-DDD 2.25
4,4-DDT 2.09
Anthracene 3.75
Benzo(a)anthracene 1.88
Benzo(a)pyrene 1.44
Benzo(g,h,i)perylene 2.08
Benzofluoranthenes 2.78
Copper 2.72
Chrysene 1.18
Dibenzo(a,h)anthracene 3.00
Fluoranthene 1.28
Fluorene 1.67
Indeno(1,2,3-cd)pyrene 2.03
Lead 2.27
Mercury 15.25
N-nitrosodiphenylamine 1.93U
Phenanthrene 1.87
Phenol 1.36
Pyrene 1.48
Total LPAH 1.77
Total HPAH 1.78
4 - 5.6 ft
Fines 52.30%
TOC 3.39%
2,4-Dimethylphenol 1.17
5.6 - 10 ft
Fines 13.80%
TOC 0.49%
MW030 0.5 - 5.5 ft
Fines 80.30%
TOC 3.26%
2,4-Dimethylphenol 1.72
2-Methylnaphthalene 1.79
Acenaphthene 14.40
Anthracene 4.48
Benzo(a)anthracene 2.81
Benzo(a)pyrene 1.50
Benzo(g,h,i)perylene 2.22
Benzofluoranthenes 2.28
Chrysene 1.75
Dibenzo(a,h)anthracene 2.57
Dibenzofuran 8.89
Fluoranthene 7.20
Fluorene 22.22
Indeno(1,2,3-cd)pyrene 1.88
Mercury 1.08
Naphthalene 1.90
N-nitrosodiphenylamine 5.71U
Phenanthrene 16.67
Pyrene 3.64
Total LPAH 10.46
Total HPAH 3.15
7 - 9 ft
Fines 23.40%
TOC 6.03%
2,4-Dimethylphenol 1.28
MW040 1.2 - 3.5 ft
Fines 41.60%
TOC 3.92%
Mercury 2.03
3.5 - 8 ft
Fines 60.20%
TOC 0.67%
8 - 9.5 ft
Fines 11.30%
TOC 0.29%
MW046 0 - 2 ft
Fines 52.00%
TOC 3.67%
Mercury 1.66
MW050 0 - 2 ft
Fines 64.90%
TOC 4.53%
2,4-Dimethylphenol 1.28
2-Methylnaphthalene 4.63
Acenaphthene 8.00
Acenaphthylene 1.31
Anthracene 6.56
Benzo(a)anthracene 3.31
Benzo(a)pyrene 3.19
Benzo(g,h,i)perylene 1.67
Benzofluoranthenes 3.72
Chrysene 1.96
Dibenzo(a,h)anthracene 2.65
Dibenzofuran 4.07
Fluoranthene 4.80
Fluorene 10.74
Indeno(1,2,3-cd)pyrene 1.88
Naphthalene 5.24
N-nitrosodiphenylamine 1.36U
Phenanthrene 8.00
Pyrene 3.03
Total LPAH 8.44
Total HPAH 3.20
TF-22 0.3 - 1.5 ft
Fines 89.00%
Mercury 2.14
Phenanthrene 1.80
Fluoranthene 1.56
Zinc 1.36
Benzo(g,h,i)perylene 1.33
Benzo(a)pyrene 1.25
Benzo(a)anthracene 1.19
Pyrene 1.18
Indeno(1,2,3-cd)pyrene 1.06
Total HPAHs 1.06
1.5 - 2.7 ft
Fines 76.00%
Acenaphthene 90.00
Phenanthrene 86.67
Fluorene 48.15
Total LPAH 46.71
Fluoranthene 28.40
Anthracene 28.13
Benzo(g,h,i)perylene 27.78
Pyrene 24.85
Benzo(a)pyrene 21.88
Indeno(1,2,3-cd)pyrene 21.74
Benzo(a)anthracene 20.00
Dibenzo(a,h)anthracene 19.57
Total HPAHs 19.32
Chrysene 11.07
Benzofluoranthenes 10.56
Dibenzofuran 8.52
Lead 6.11
Acenaphthylene 4.85
Naphthalene 4.10
2-Methylnapthalene 4.03
Zinc 1.41
4,4-DDT 1.18U
MW025 0.4 - 5 ft
Fines 49.00%
TOC 3.79%
Mercury 2.03
5 - 8 ft
Fines 12.70%
TOC 0.33%
8 - 12 ft
Fines 21.00%
TOC 0.51%
MIDDLE WATERWAY
WATERWAY LINE
PIERHEAD LINE
BULKHEAD LINE
SCALE IN FEET
0
300
600
Surface Sediment and Co-located Subsurface Sediment Core Location
Shallow (0-2 feet) Subsurface Sediment Sample Location (1 composite sample)
Historical Stations
Property Line (Including Leases)
* 10 chemicals had detection limits greater than SQO in each interval of MW-1
LEGEND
Station
Depth
Percent Fines %
Percent TOC %
Chemical Exceedence Factor
MIDDLE WATERWAY
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Figure 5
Middle Waterway Problem Area
Round 1A Subsurface Samples
And Exceedence Factors
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mr1afg12.DWG

MW03a	Surface
Fines	10. 70%
TOC	2. 85%
4, 4-DDD	1. 44
Acenaphthene	1. 34
Mercury	1. 47
PCB (total)	2. 30

MW03b	Surface
Fines	18. 80%
TOC	3. 12%
2, 4 Dimethylphenol	2. 76
Pentachlorophenol	2. 22

B-18	Surface
Fines	11. 0%
TOC	2. 7%
Benzo(a)anthracene	2. 50
Benzo(a)pyrene	3. 63
Benzo(g, h, i)perylene	5. 83
Benzofluoranthenes	2. 28
Chrysene	1. 61
Dibenzo(a, h)anthracene	5. 65
Fluoranthene	1. 44
Indeno(1, 2, 3-cd)pyrene	5. 51
Phenanthrene	1. 33
Pyrene	1. 52
Total HPAH	2. 38

B-19	Surface
Fines	20. 0%
TOC	2. 3%
Anthracene	1. 46
Benzo(a)anthracene	2. 94
Benzo(a)pyrene	3. 13
Benzo(g, h, i)perylene	3. 89
Benzofluoranthenes	1. 89
Bis(2-Ethylhexyl)phtha	1. 08
Chrysene	1. 93
Dibenzo(a, h)anthracene	3. 87
Fluoranthene	2. 56
Fluorene	1. 09
Indeno(1, 2, 3-cd)pyrene	3. 19
Phenanthrene	3. 33
Pyrene	2. 58
Total HPAH	2. 51
Total LPAH	1. 68

MW04b-SP	Surface
Fines	6. 20%
TOC	2. 69%
2-Methylphenol	4. 13
Benzoic acid	1. 52
Benzyl alcohol	1. 16
Mercury	1. 15

B-16	Surface
Fines	16. 0%
TOC	1. 7%
Benzo(a)anthracene	1. 63
Benzo(a)pyrene	1. 81
Benzo(g, h, i)perylene	2. 36
Benzofluoranthenes	1. 22
Chrysene	1. 11
Dibenzo(a, h)anthracene	2. 04
Fluoranthene	1. 44
Indeno(1, 2, 3-cd)pyrene	2. 03
Phenanthrene	2. 93
Pyrene	1. 58
Total HPAH	1. 49
Total LPAH	1. 16
Zinc	1. 14

B-17	Surface
Fines	17. 0%
TOC	3. 2%
Benzo(g, h, i)perylene	1. 21
Dibenzo(a, h)anthracene	1. 22
Indeno(1, 2, 3-cd)pyrene	1. 03
Phenanthrene	1. 20

MW11b	Surface
Fines	12. 90%
TOC	1. 79%
Mercury	1. 05

MW04b	Surface
Fines	20. 90%
TOC	3. 50%

MW04a	Surface
Fines	12. 30%
TOC	1. 22%

MW015	Surface
Fines	15. 70%
TOC	1. 49%
2-Methylphenol	1. 41U

MW002	Surface
Fines	11. 90%
TOC	1. 00%

MW012	Surface
Fines	19. 60%
TOC	4. 86%
Mercury	2. 20

MW001	Surface
Fines	11. 80%
TOC	2. 00%
2, 4-Dimethylphenol	1. 48u
2-Methylphenol	1. 22u

MW11a	Surface
Fines	5. 70%
TOC	0. 85%
Mercury	7. 12
N-Nitrosodiphenylamine	1. 25

MW013	Surface
Fines	5. 40%
TOC	0. 52%
Copper	2. 79
Mercury	3. 90

MW014	Surface
Fines	3. 70%
TOC	1. 70%
Mercury	1. 29

MW11a-SP	Surface
Fines	4. 70%
TOC	1. 72%
Arsenic	2. 12
Benzofluoranthenes	1. 06
Copper	1. 55
Fluoranthene	1. 12
Mercury	4. 24
N-Nitrosodiphenylamine	2. 18
Zinc	2. 42

MW009	Surface
Fines	43. 00%
TOC	3. 29%
Benzo(a)anthracene	2. 13
Benzo(a)pyrene	1. 50
Benzofluoranthenes	2. 78
Chrysene	1. 14
Fluoranthene	3. 12
Mercury	3. 39
Phenanthrene	1. 53
Pyrene	1. 67
Total HPAH	1. 97

B-13	Surface
Fines	19. 0%
TOC	1. 6%

B-12	Surface
Fines	16. 0%
TOC	1. 7%
Arsenic	1. 33
Benzo(g, h, i)perylene	1. 36
Copper	2. 51
Dibenzo(a, h)anthracene	1. 22
Indeno(1, 2, 3-cd)pyrene	1. 26
Zinc	3. 88

MW10a	Surface
Fines	17. 40%
TOC	1. 37%
Arsenic	2. 91
Benzo(a)anthracene	1. 19
Benzo(g, h, i)perylene	1. 01
Benzofluoranthenes	1. 72
Benzoic acid	1. 12
Copper	5. 51
Dibenzo(a, h)anthracene	1. 57
Fluoranthene	1. 72
Indeno(1, 2, 3-cd)pyrene	1. 13
Lead	1. 73
Mercury	3. 05
Phenanthrene	1. 60
Total HPAH	1. 22
Zinc	3. 39

MW10b	Surface
Fines	17. 40%
TOC	1. 72%
Arsenic	2. 28
Benzo(a)anthracene	1. 13
Benzofluoranthenes	2. 06
Copper	3. 51
Lead	7. 16
Mercury	3. 22
Pentachlorophenol	1. 89
Silver	1. 02
Total HPAH	1. 12
Zinc	3. 24

MW10c	Surface
Fines	13. 60%
TOC	2. 15%
2, 4-Dimethylphenol	2. 17
4, 4-DDE	1. 11U
Arsenic	2. 30
Benzo(a)pyrene	1. 13
Benzo(g, h, i)perylene	1. 81
Benzofluoranthenes	2. 17
Copper	4. 26
Fluoranthene	1. 16
Indeno(1, 2, 3-cd)pyrene	1. 74
Lead	3. 98
Mercury	49. 49
PCB (total)	1. 37
Phenanthrene	1. 60
Phenol	1. 21
Total HPAH	1. 28
Zinc	2. 78

MW009-SP	Surface
Fines	64. 10%
TOC	3. 60%
Benzofluoranthenes	1. 67
Copper	1. 05
Fluoranthene	1. 16
Indeno(1, 2, 3-cd)pyrene	1. 07
Mercury	2. 71
Phenanthrene	1. 13
Total HPAH	1. 05
Zinc	1. 17

MW008-SP	Surface
Fines	11. 10%
TOC	3. 16%
4, 4-DDE	2. 44
4, 4-DDT	1. 12
PCB (total)	2. 50

MW008	Surface
Fines	15. 10%
TOC	2. 59%
Benzyl alcohol	1. 36

B-14	Surface
Fines	30. 0%
TOC	2. 8%
Acenaphthene	1. 88
Anthracene	3. 85
Benzo(a)anthracene	9. 38
Benzo(a)pyrene	10. 00
Benzo(g, h, i)perylene	6. 94
Benzofluoranthenes	5. 28
Chrysene	5. 71
Copper	3. 67
Dibenzo(a, h)anthracene	7. 83
Fluoranthene	8. 80
Fluorene	2. 22
Indeno(1, 2, 3-cd)pyrene	6. 38
Nickel	2. 78
PCB (total)	2. 30
Phenanthrene	13. 33
Pyrene	81. 82
Total HPAH	21. 72
Total LPAH	5. 23
Zinc	1. 30

B-15	Surface
Fines	25. 0%
TOC	3. 3%
Benzo(a)anthracene	2. 19
Benzo(a)pyrene	2. 88
Benzo(g, h, i)perylene	4. 03
Benzofluoranthenes	1. 94
Chrysene	1. 32
Copper	4. 44
Dibenzo(a, h)anthracene	3. 61
Dimethylphthalate	2. 00
Fluoranthene	1. 72
Indeno(1, 2, 3-cd)pyrene	3. 62
Mercury	18. 47
Nickel	12. 71
PCB (total)	9. 33
Phenanthrene	2. 73
Pyrene	1. 85
Total HPAH	2. 08
Total LPAH	1. 15
Zinc	2. 88

LEGEND

- Bank Samples
- Discrete Bank Samples
- Historical Stations
- B-12 — Waterway Bank Composite (B-3, B-10, and B-11 subsectioned)
- Property Line (Including Leases)

Station	Depth
Percent Fines	%
Percent TOC	%
Chemical Exceedence Factor	

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Figure 6
Middle Waterway Problem Area
Round 1A Bank Samples
And Exceedence Factors

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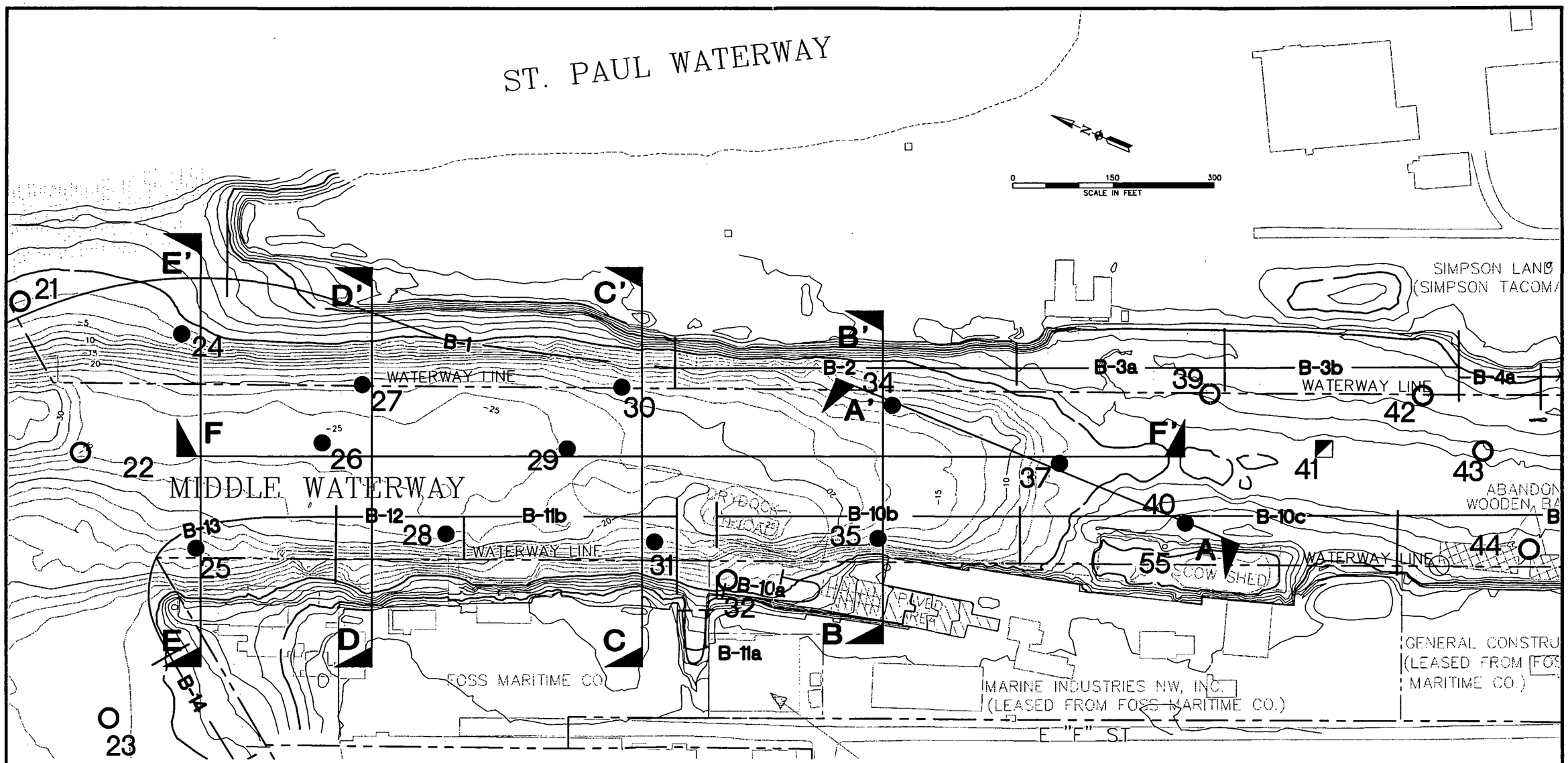
mr1afg13.DWG



LEGEND

—B-12— Waterway Bank Composite (B–3, B–10, and B–11 subsectioned)

O Surface Sediment Sample Location

● Surface Sediment and Co–located Subsurface Sediment Core Location

NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.
2. Horizontal Datum: WA State Plane South Zone (NAD83–91)
   Vertical Datum: COE Mean Lower Low Water (MLLW)

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Figure 7
Middle Waterway Problem Area
Round 1A Stations
GEOLOGIC CROSS SECTION LOCATIONS

mr1axs02.DWG

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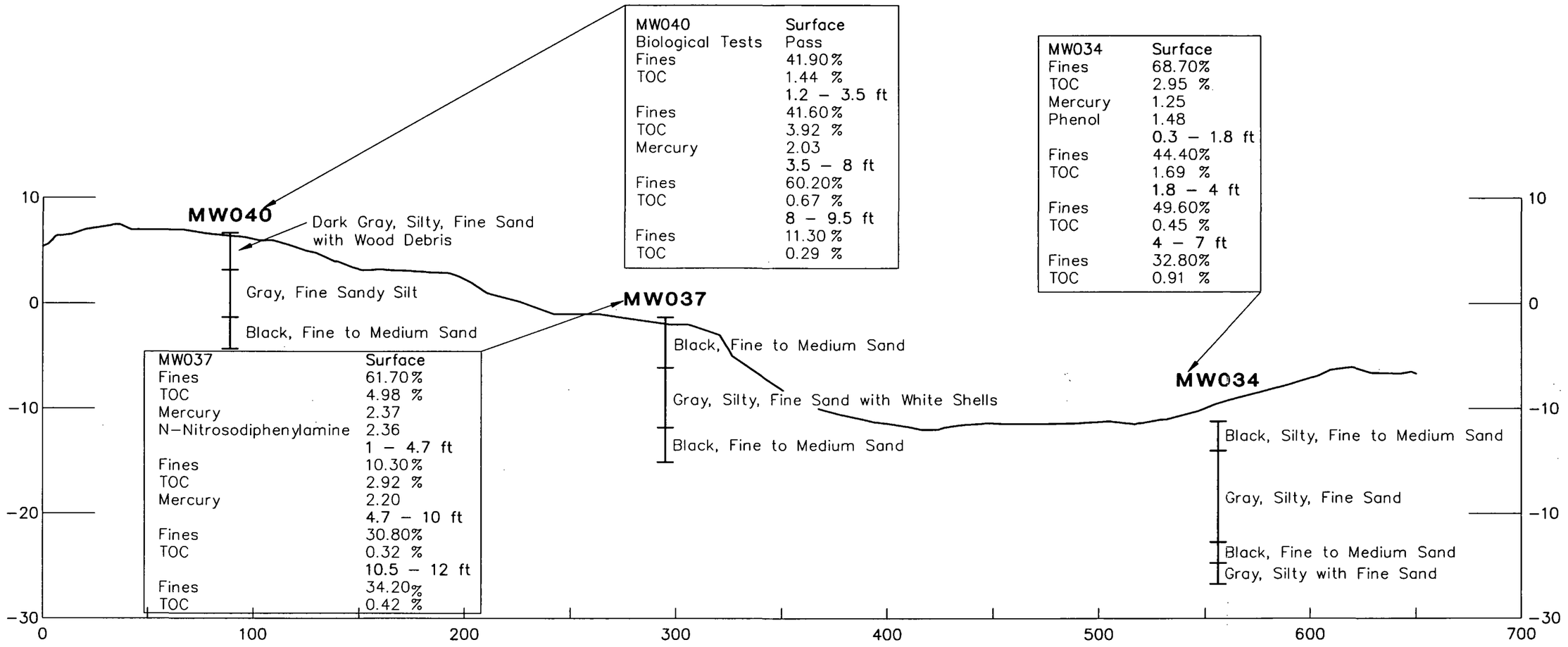

SECTION A-A'

SCALE – 1"=50' HOR
1"=10' VERT

LEGEND

MW040

Subsurface core location and elevations of top and bottom of sediment recovered.

Existing mudline

NOTES

1. **The stratigraphic contacts are generalizations based on visual observations and test data. Variations between generalizations shown and actual conditions should be expected.**
2. **Refer to Figure 7 for cross section locations.**

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Figure 8
Middle Waterway Problem Area
Round 1A Stations
CROSS SECTION A–A'

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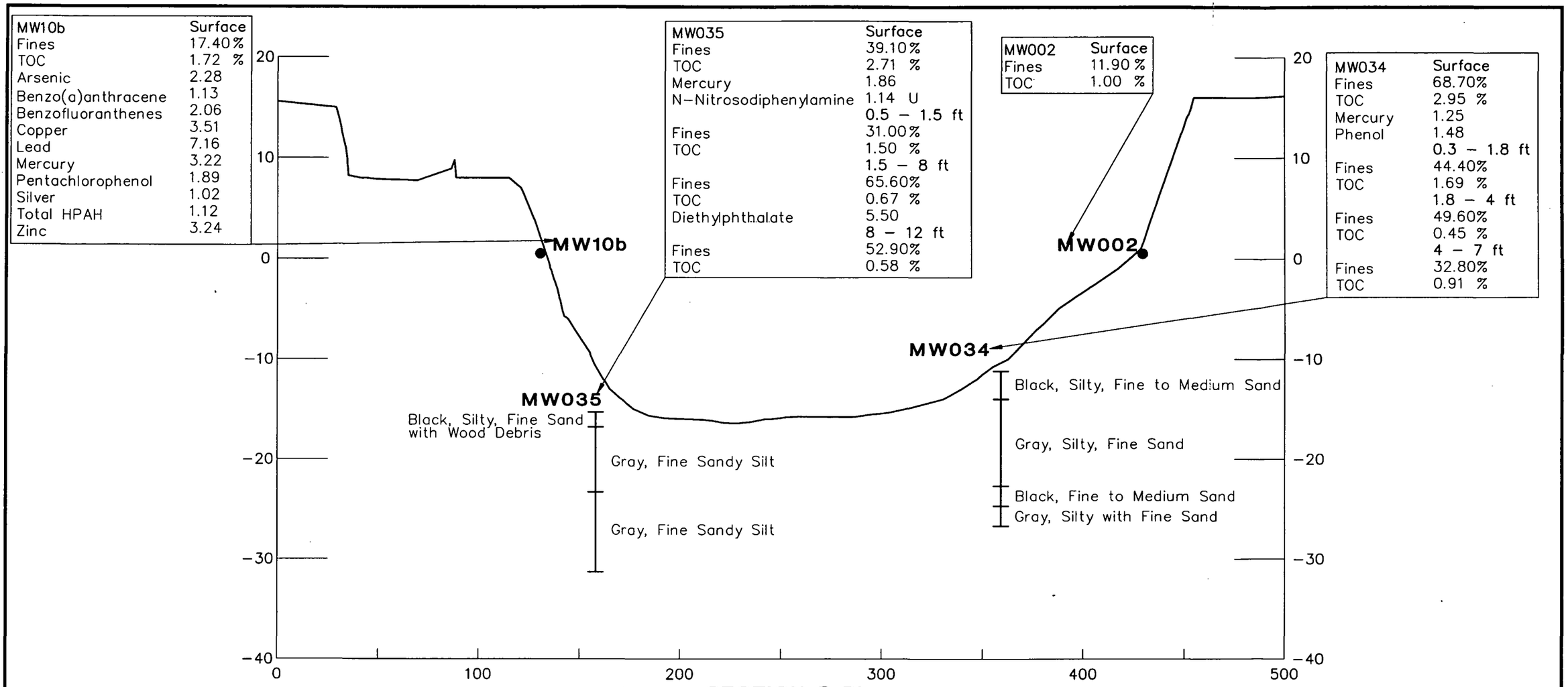
mr1axs02.dwg



SECTION B-B'

SCALE – 1"=50' HOR
1"=10' VERT

LEGEND

MW040

Subsurface core location and elevations of top and bottom of sediment recovered.

Existing mudline

NOTES

1. The stratigraphic contacts are generalizations based on visual observations and test data. Variations between generalizations shown and actual conditions should be expected.
2. Refer to Figure 7 for cross section locations.

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Figure 9
Middle Waterway Problem Area
Round 1A Stations
CROSS SECTION B–B'

I:\PROJECTS\16990013\DWG\MR1AXS02.DWG
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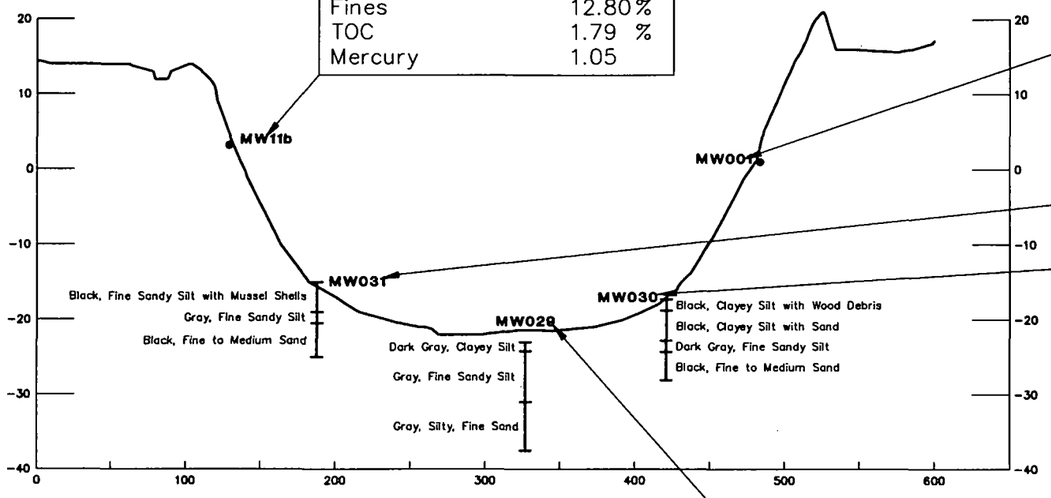
mr1axs02.dwg



SECTION C-C'

SCALE - 1"=100' HOR
1"=20' VERT

MW11b	Surface
Fines	12.80%
TOC	1.79 %
Mercury	1.05

MW001	Surface
Fines	11.80 %
TOC	2.00 %
2,4-Dimethylphenol	1.48 U
2-Methylphenol	1.22 U

FOR SURFACE SAMPLE SEE FIGURE 11

MW031	1.7 - 4 ft
Fines	31.30%
TOC	5.86 %
2,4-Dimethylphenol	3.38
4,4-DDD	2.25
4,4-DDT	2.09
Anthracene	3.75
Benzo(a)anthracene	1.88
Benzo(a)pyrene	1.44
Benzo(g,h,i)perylene	2.08
Benzofluoranthenes	2.78
Copper	2.72
Chrysene	1.18
Dibenzo(a,h)anthracene	3.00
Fluoranthene	1.28
Fluorene	1.67
Indeno(1,2,3-cd)pyrene	2.03
Lead	2.27
Mercury	15.25
N-Nitrosodiphenylamine	1.93 U
Phenanthrene	1.87
Phenol	1.36
Pyrene	1.48
Total LPAH	1.77
Total HPAH	1.78
	4 - 5.6 ft
Fines	52.30%
TOC	3.39 %
2,4-Dimethylphenol	1.17
	5.6 - 10 ft
Fines	13.80%
TOC	0.49 %

MW030	Surface
Fines	67.00%
TOC	3.61 %
Mercury	3.39
	0.5 - 5.5 ft
Fines	80.30%
TOC	3.26 %
2,4-Dimethylphenol	1.72
2-Methylnaphthalene	1.79
Acenaphthene	14.40
Anthracene	4.48
Benzo(a)anthracene	2.81
Benzo(a)pyrene	1.50
Benzo(g,h,i)perylene	2.22
Benzofluoranthenes	2.28
Chrysene	1.75
Dibenzo(a,h)anthracene	2.57
Dibenzofuran	8.89
Fluoranthene	7.20
Fluorene	22.22
Indeno(1,2,3-cd)pyrene	1.88
Mercury	1.08
Naphthalene	1.90
N-Nitrosodiphenylamine	5.71 U
Phenanthrene	16.67
Pyrene	3.64
Total LPAH	10.46
Total HPAH	3.15
	7 - 9 ft
Fines	23.40%
TOC	6.03 %
2,4-Dimethylphenol	1.28

MW029	Surface
Fines	64.70%
TOC	3.02 %
Mercury	2.03
	1.2 - 4 ft
Fines	26.10%
TOC	0.36 %
	4 - 8 ft
Fines	51.00%
TOC	0.38 %
	8 - 12 ft
Fines	35.60%
TOC	0.45 %

Subsurface core location and elevations of top and bottom of sediment recovered.

Existing mudline

MIDDLE WATERWAY
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NOTES

1. **The stratigraphic contacts are generalizations based on visual observations and test data. Variations between generalizations shown and actual conditions should be expected.**
2. **Refer to Figure 7 for cross section locations.**

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Figure 10
Middle Waterway Problem Area
Round 1A Stations
CROSS SECTION C-C'

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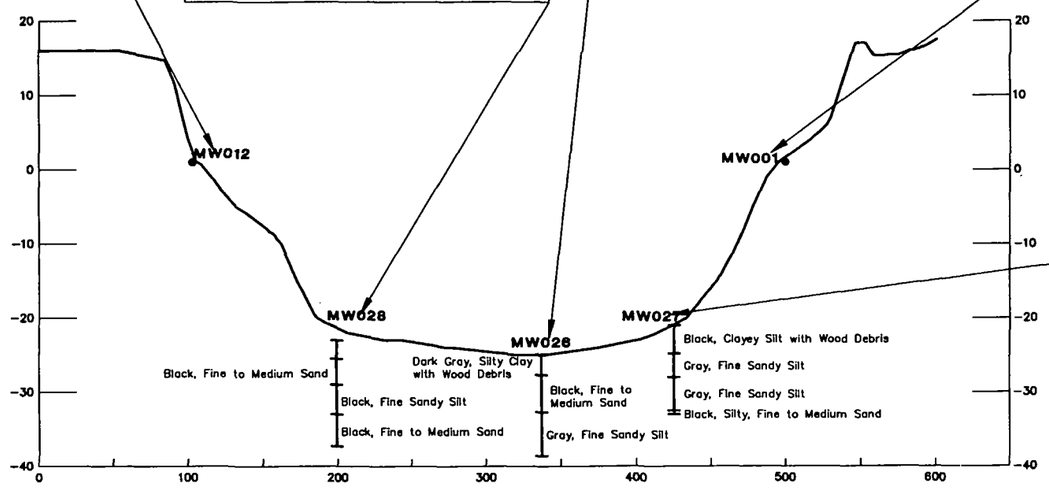
mr1axs02.dwg

MW012	Surface
Fines	19.60%
TOC	4.86 %
Mercury	2.20

MW028	Surface
Fines	27.20%
TOC	1.26 %
Fluorene	1.02
	0.3 – 2.5 ft
Fines	21.60%
TOC	1.47 %
	2.5 – 6 ft
Fines	10.50%
TOC	0.75 %
	6 – 10 ft
Fines	69.80%
TOC	1.41 %

MW026	Surface
Fines	46.70%
TOC	2.44 %
Arsenic	1.23
Zinc	1.03
	0.4 – 2.7 ft
Fines	86.90%
TOC	0.98 %
	5 – 8 ft
Fines	56.20%
TOC	0.43 %
	8 – 12 ft
Fines	60.60%
TOC	0.40 %

MW001	Surface
Fines	11.70 %
TOC	2.00 %
2,4–Dimethylphenol	1.48 U
2–Methylphenol	1.22 U



SECTION D-D'

SCALE – 1"=100' HOR
1"=20' VERT

MW027	Surface
Fines	58.30%
TOC	3.32 %
Mercury	1.51
	1 – 3.8 ft
Fines	44.20%
TOC	5.95 %
2,4–Dimethylphenol	2.14
4,4–DDD	1.13
4,4–DDE	1.09
Acenaphthene	1.32
Antimony	3.11
Arsenic	2.28
Copper	7.44
Fluoranthene	1.28
Fluorene	1.59
Mercury	10.17
Phenanthrene	1.13
Silver	6.51
Total LPAH	1.07
Zinc	1.37
	3.8 – 7 ft
Fines	82.90%
TOC	1.43 %
Acenaphthene	3.00
Anthracene	2.29
Dibenzofuran	1.85
Fluoranthene	1.72
Fluorene	5.56
N–Nitrosodiphenylamine	1.18 U
Phenanthrene	4.40
Total LPAH	2.76
	7– 11.5 ft
Fines	62.40%
TOC	0.65 %
2,4–Dimethylphenol	1.24

LEGEND

MW040

Subsurface core location and elevations of top and bottom of sediment recovered.

Existing mudline

NOTES

1. **The stratigraphic contacts are generalizations based on visual observations and test data. Variations between generalizations shown and actual conditions should be expected.**
2. **Refer to Figure 7 for cross section locations.**

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Figure 11
Middle Waterway Problem Area
Round 1A Stations
CROSS SECTION D–D'

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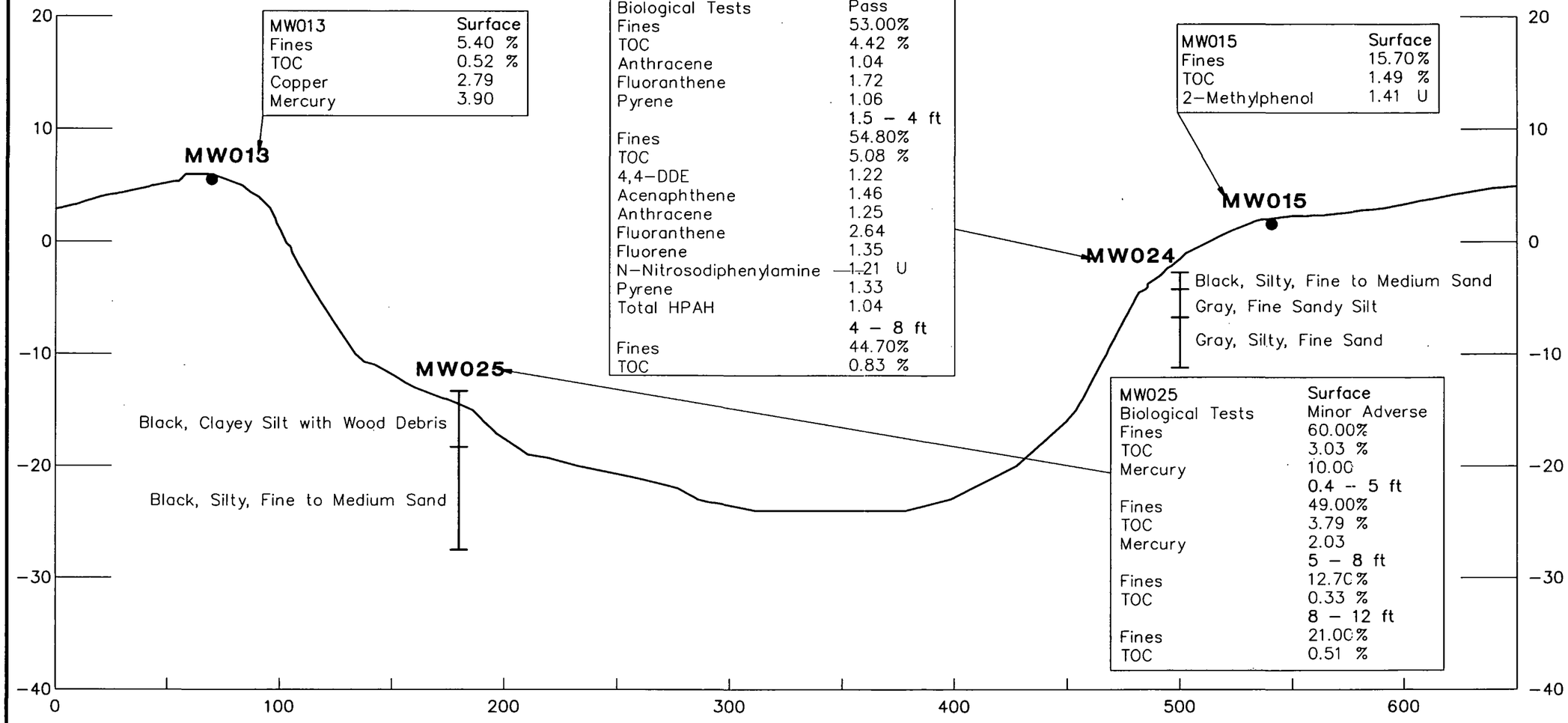

SECTION E-E'

SCALE – 1"=50' HOR
1"=10' VERT

LEGEND

MW040

Subsurface core location and elevations of top and bottom of sediment recovered.

Existing mudline

NOTES

1. The stratigraphic contacts are generalizations based on visual observations and test data. Variations between generalizations shown and actual conditions should be expected.
2. Refer to Figure 7 for cross section locations.

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Figure 12
Middle Waterway Problem Area
Round 1A Stations
CROSS SECTION E–E'

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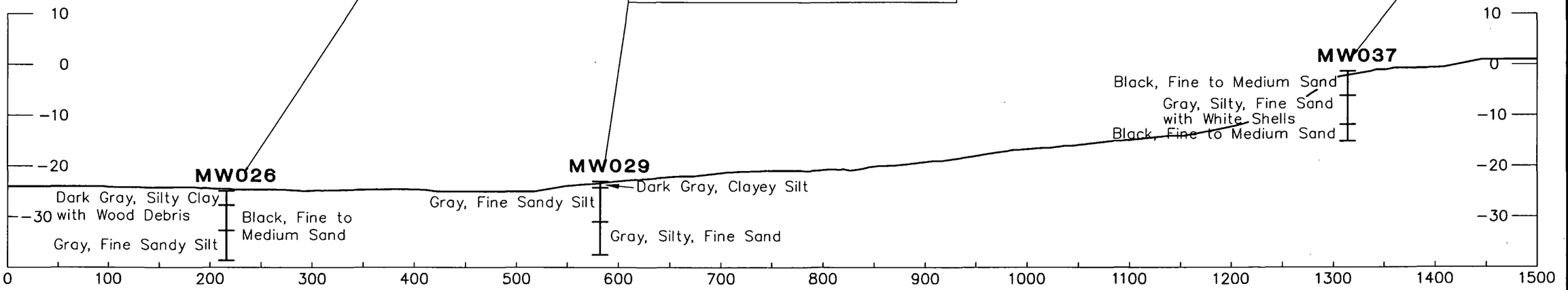
mr1axs02.dwg

MW026	Surface
Fines	46.70%
TOC	2.44 %
Arsenic	1.23
Zinc	1.03
	0.4 – 2.7 ft
Fines	86.90%
TOC	0.98 %
	5 – 8 ft
Fines	56.20%
TOC	0.43 %
	8 – 12 ft
Fines	60.60%
TOC	0.40 %

MW029	Surface
Fines	64.70%
TOC	3.02 %
Mercury	2.03
	1.2 – 4 ft
Fines	26.10%
TOC	0.36 %
	4 – 8 ft
Fines	51.00%
TOC	0.38 %
	8 – 12 ft
Fines	35.60%
TOC	0.45 %

MW037	Surface
Fines	61.70%
TOC	4.98 %
Mercury	2.37
N–Nitrosodiphenylamine	2.36
	1 – 4.7 ft
Fines	10.30%
TOC	2.92 %
Mercury	2.20
	4.7 – 10 ft
Fines	30.80%
TOC	0.32 %
	10.5 – 12 ft
Fines	34.20%
TOC	0.42 %



SECTION F-F'

SCALE – 1"=100' HOR
1"=20' VERT

LEGEND

MW040

Subsurface core location and elevations of top and bottom of sediment recovered.

Existing mudline

NOTES

1. The stratigraphic contacts are generalizations based on visual observations and test data. Variations between generalizations shown and actual conditions should be expected.
2. Refer to Figure 7 for cross section locations.

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Figure 13
Middle Waterway Problem Area
Round 1A Stations
CROSS SECTION F–F'

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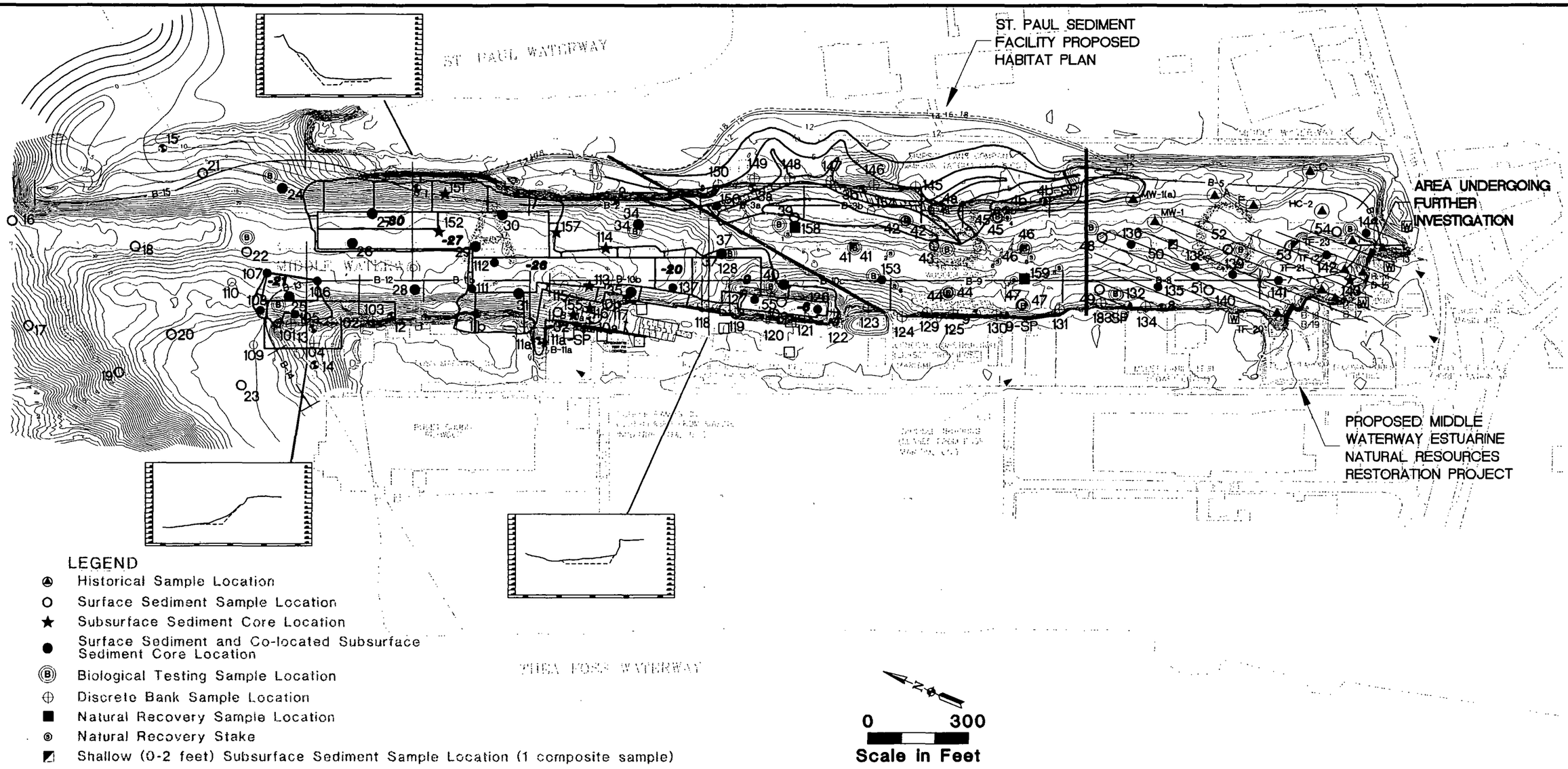

LEGEND

- Historical Sample Location
- Surface Sediment Sample Location
- Subsurface Sediment Core Location
- Surface Sediment and Co-located Subsurface Sediment Core Location
- Biological Testing Sample Location
- Discrete Bank Sample Location
- Natural Recovery Sample Location
- Natural Recovery Stake
- Shallow (0-2 feet) Subsurface Sediment Sample Location (1 composite sample)
- Representative Location of Composite Bank Sample
- Supplemental Sample Location
- Hollow Stem Auger - Geotechnical Boring
- Hollow Stem Auger - Well Development
- —B-12— Waterway Bank Sections (B-3, B-10, and B-11 subsectioned)
- ----- Property Line (Including Leases)
- -30 Potential Dredge Cut Elevation

WATERWAY AREAS

- A Working Waterway Area
- B Central Tide Flats
- C Head

NOTES:

1. **Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.**
2. **Horizontal Datum: WA State Plane South Zone (NAD83)**
   Vertical Datum: Port of Tacoma Mean Lower Low Water

ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

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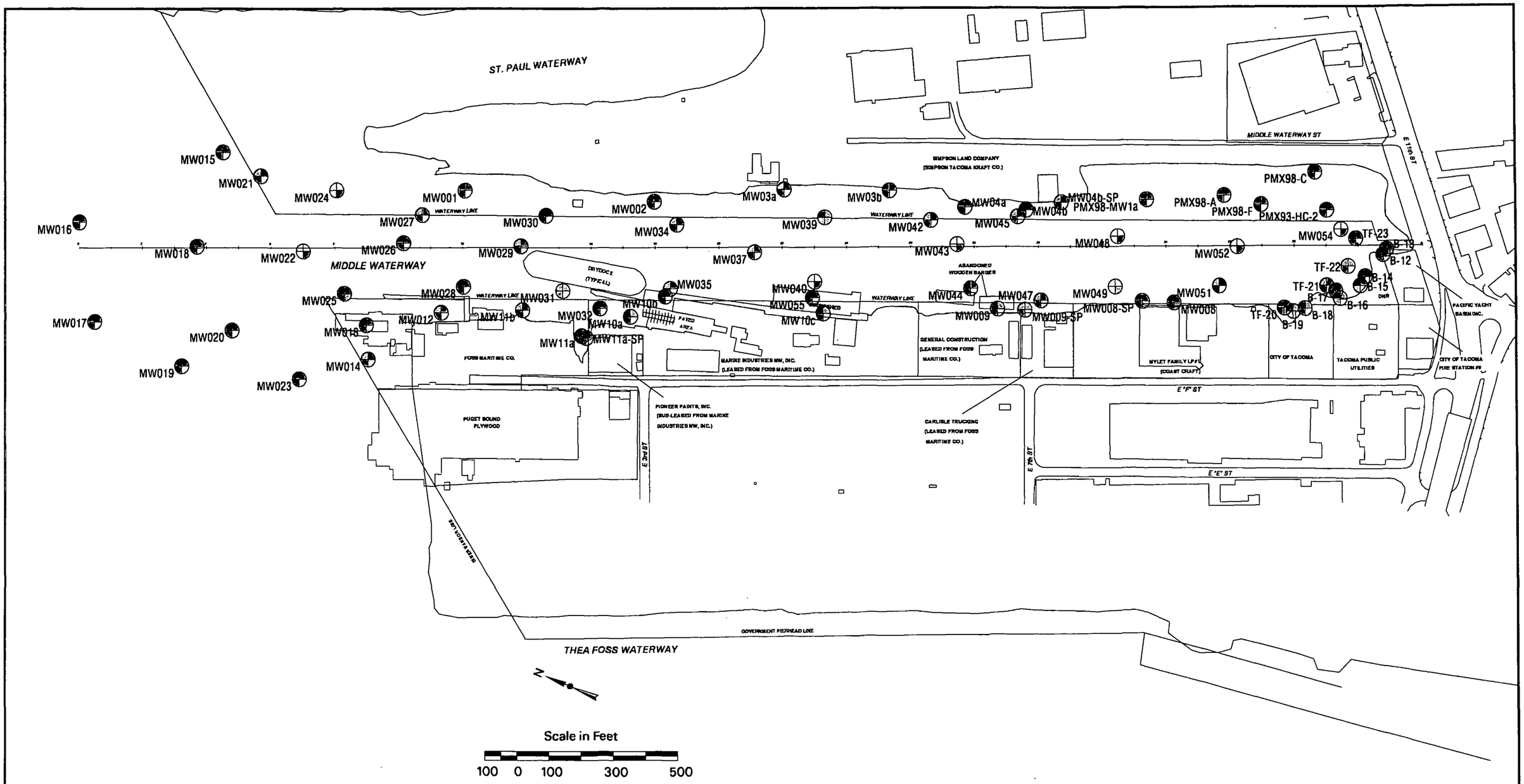
Figure 14
Middle Waterway Problem Area
Preliminary Remediation Concept



LEGEND

Hg / HPAH / LPAH / Biological

Chemical Exceedence Factor	Biological Test Result
● 0 < x < = 1	● Pass
◍ 1 < x < = 3	◍ Minor Adverse
● x > 3	● Adverse
⊕ Chemical test overruled by confirmatory biological tests	◕ No Biological Test

MIDDLE WATERWAY
Protecting the Environment, Powering the Economy

NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.
2. Horizontal Datum: WA state plane south zone (NAD83-91)
   Vertical Datum: COE mean lower low water

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Figure 15
Middle Waterway
Surface and Bank Sample Exceedence Factors for
Mercury, HPAH, LPAH and Biological Test Results

/cas3/bruce/ps-samples.aml - August 16, 1999

ST. PAUL WATERWAY

ST. PAUL SEDIMENT FACILITY PROPOSED HABITAT PLAN

MIDDLE WATERWAY ST

E 11th ST

MIDDLE WATERWAY

COMMENCEMENT BAY

SIMPSON LAND COMPANY (SIMPSON TACOMA KRAFT CO.)

ABANDONED WOODEN BARGES

FOSS MARITIME CO.

RETAINING WALL

MARINE INDUSTRIES NW, INC. (LEASED FROM FOSS MARITIME CO.)

AREA OF ENLARGEMENT

GENERAL CONSTRUCTION (LEASED FROM FOSS MARITIME CO.)

MYLET FAMILY LP #1 (COAST CRAFT)

CITY OF TACOMA TACOMA PUBLIC UTILITIES

CITY OF TACOMA FIRE STATION #6

PACIFIC YACHT BASIN INC.

PUGET SOUND PLYWOOD

PIONEER PAINTS, INC. (SUB-LEASED FROM MARINE INDUSTRIES NW, INC.)

CARLISLE TRUCKING (LEASED FROM FOSS MARITIME CO.)

E 3rd ST

E 7th ST

E "E" ST

E "F" ST

PROPOSED MIDDLE WATERWAY ESTUARINE NATURAL RESOURCES RESTORATION PROJECT

0 300

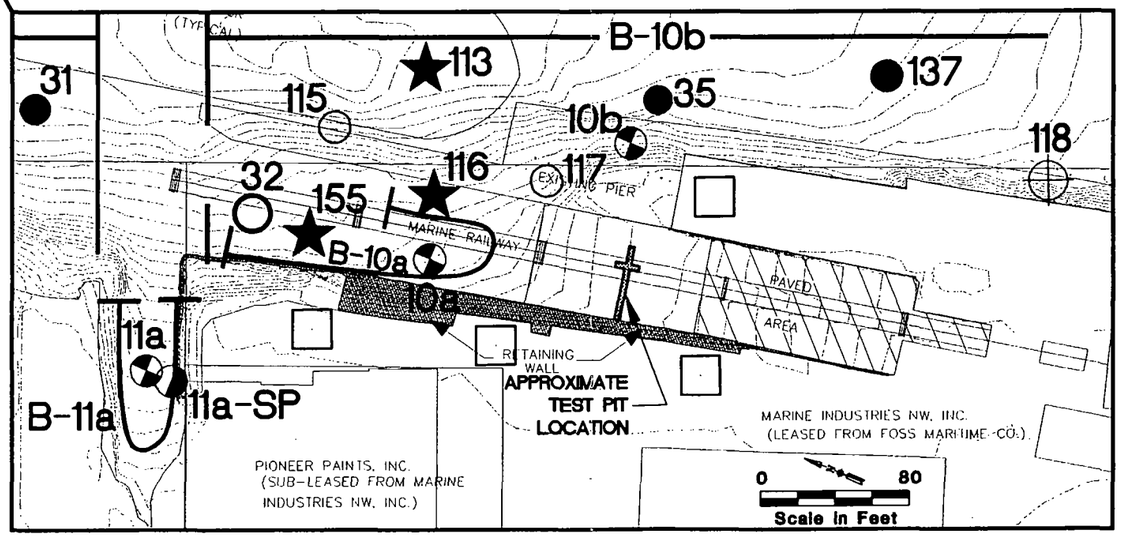
Scale in Feet

LEGEND

- Historical Sample Location
- Surface Sediment Sample Location
- Subsurface Sediment Core Location
- Surface Sediment and Co-located Subsurface Sediment Core Location
- Biological Testing Sample Location
- Discrete Bank Sample Location
- Natural Recovery Sample Location
- Natural Recovery Stake
- Shallow (0-2 feet) Subsurface Sediment Sample Location (1 composite sample)
- Representative Location of Composite Bank Sample
- Supplemental Sample Location
- Hollow Stem Auger - Geotechnical Boring
- Hollow Stem Auger - Well Development
- —B-12— Waterway Bank Sections (B-3, B-10, and B-11 subsectioned)
- ———— Property Line (Including Leases)

WATERWAY AREAS

- A Working Waterway Area
- B Central Tide Flats
- C Head



MARINE RAILWAY ENLARGEMENT

ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

MIDDLE WATERWAY
Protecting the Environment, Promoting the Economy

NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.
2. Horizontal Datum: WA State Plane South Zone (NAD83)
   Vertical Datum: COE Mean Lower Low Water

Figure 16
Middle Waterway Problem Area
Proposed Round 1B Sample Stations

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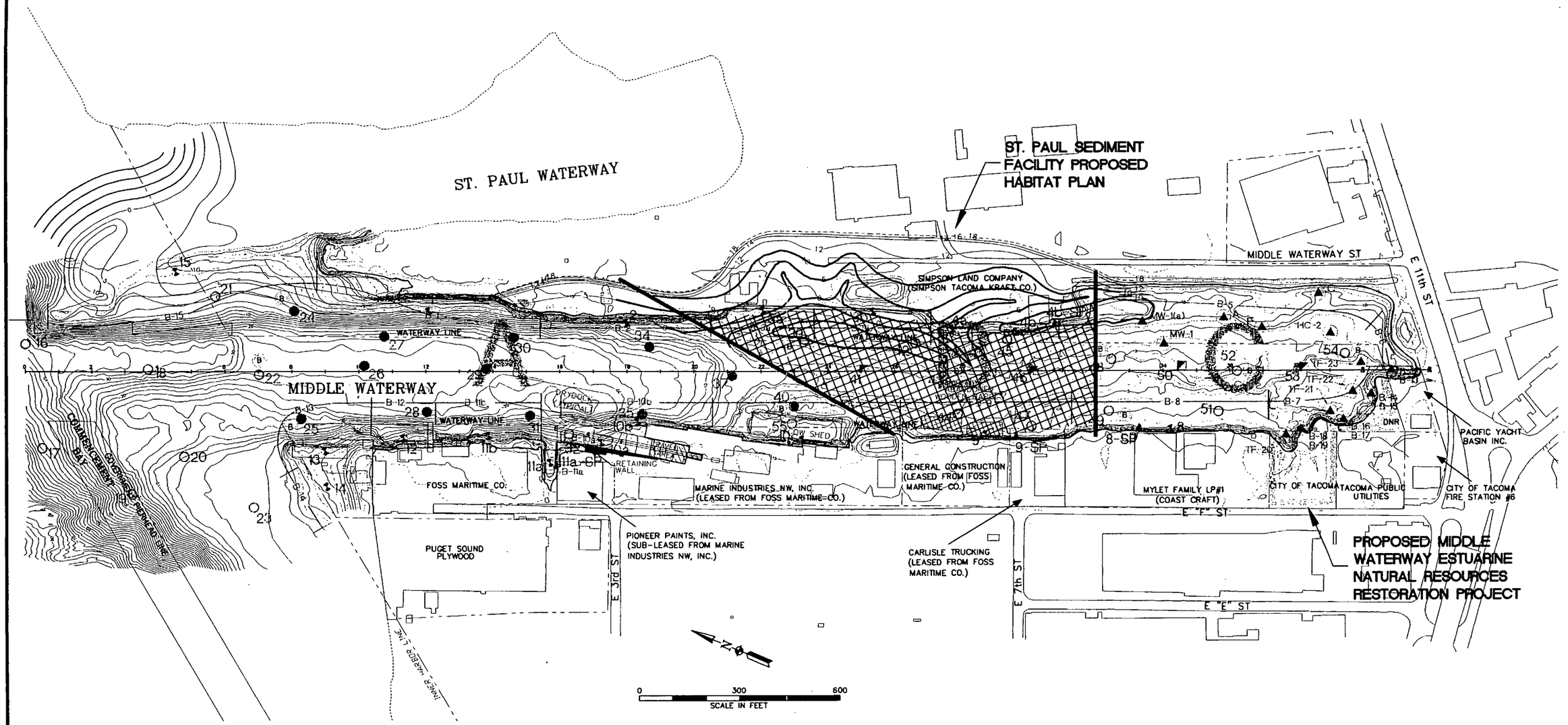

LEGEND

Potential Natural Recovery Area

NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.
2. Horizontal Datum: WA State Plane South Zone (NAD83)
   Vertical Datum: COE Mean Lower Low Water
3. Potential natural recovery areas subject to modification based on Round 1B results and the results of the natural recovery demonstration presented in Data Evaluation Report.

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Figure 17
Middle Waterway Problem Area
Potential Natural Recovery Areas

APPENDIX A

CORE LOGS

SEDIMENT CLASSIFICATION SYSTEM

SAMPLE DESCRIPTION

Classification of sediments in this report are based on visual observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 modified by use of PSEP definition of clay, silt, sand, and gravel were used.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in surface samples or cores estimated based on visual observation.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot
Very loose	0 - 4	Very soft	0 - 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Medium stiff	4 - 8
Dense	30 - 50	Stiff	8 - 15
Very dense	>50	Very stiff	15 - 30
		Hard	>30

LEGEND FOR SOIL DESCRIPTION

Soil Descriptions format:

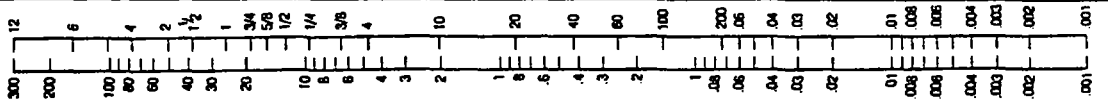
"Moisture, color, modifying constituent, MAJOR CONSTITUENT, with minor constituents"

Coarse-Grained Sediment		Fine-Grained Sediment	
Silt or Clay Modifying Constituent:	>12%	Modifying Constituent:	>30%
Silt or Clay Minor Constituent:	5 to 12%	Minor Constituent:	15 to 29%
Sand or Gravel Minor Constituent:	>15%		

SEDIMENT CLASSIFICATION SYSTEM

GRAND SIZE

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimeters



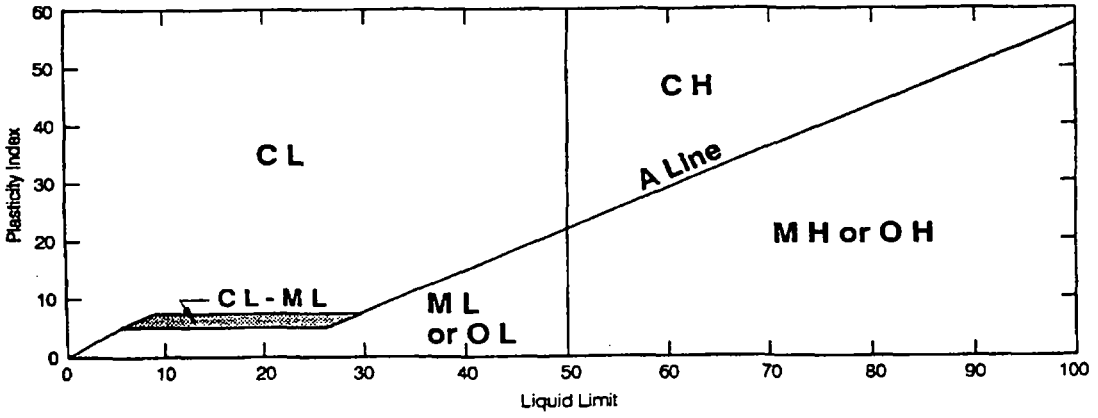
COBBLES	GRAVEL	SAND	SILT	CLAY
Coarse-Grained Soils			Fine-Grained Soils	

COARSE-GRAINED SOILS

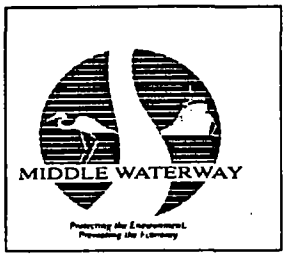
G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines		GRAVEL with >12% fines		Clean SAND <5% fines		SAND with >12% fines	
GRAVEL >50% coarse fraction larger than 2.0 mm				SAND > 50% coarse fraction smaller than 2.0 mm			
Coarse-Grained Soils >50% larger than 0.0625 mm							

FINE-GRAINED SOILS

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than 0.0625 mm						



1. Size classification based on Puget Sound Estuary Program (PSEP) test method for "Conventional Sediment Variables"
2. Classification based on American Society of Testing and Materials (ASTM) D-2487.



MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	4.9
Water Depth	7.6
Mudline Elev.	-2.7

	Field	Lab
Date	5/12/98	5/13/98
Time	928	1200

CORE LOCATION	MW024
DRIVE LENGTH, ft.	10.5
RECOVERY, ft.	8.5
RECOVERY, %	81

LAB. GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
2	44	46	9
0	55	40	4

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
		Wet, black, organic SILT.	1
		Wet, black, fine to medium SAND.	2
R2A			
	R2A 1.5-4.0	Wet, gray, silty, fine SAND to fine sandy SILT.	3
			4
			5
	R3A		
R3A	4.0-8.0	Wet, gray, silty, fine SAND.	6
			7
			8
			9
			10
			11
			12
			13
			14
			15
			16
			17

SUMMARY LOG BASED ON INSITU DEPTHS

Organic SILT

Fine to Medium SAND

Silty fine SAND and Fine sandy SILT.

NOTES
1. The stratigraphic contacts are generalizations based on visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-1** Middle Waterway Phase 1A Sampling Stations CORE LOGS

MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	4.9
Water Depth	19.0
Mudline Elev.	-13.3

	Field	Lab
Date	5/11/98	5/12/98
Time	1508	1540

CORE LOCATION	**MW025**
DRIVE LENGTH, ft.	17.0
RECOVERY, ft.	14.2
RECOVERY, %	84

GRAIN SIZE in percent

GRAVEL	SAND	SILT	CLAY
6	45	39	10
0	87	10	3
1	78	17	4

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description
R2A	R2A 0.4-5.0	Wet, black, organic, clayey, sandy SILT with 2 inch long wood debris.
R3A	R3A 5.0-8.0	Wet, black, fine to medium SAND with silt.
R4A	R4A 8.0-12.0	Wet, black, fine to medium SAND with silt.
R5A		

DEPTH: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

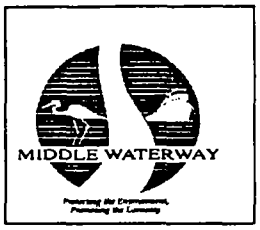
NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. *Soil descriptions based on ASTM D-2488 Method.*
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

Organic SILT with wood chips.

Fine to medium SAND.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-2** Middle Waterway Phase 1A Sampling Stations CORE LOGS



MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	1.8
Water Depth	26.7
Mudline Elev.	-24.9

	Field	Lab
Date	5/11/98	5/12/98
Time	1332	1400

CORE LOCATION	MW026
DRIVE LENGTH, ft.	17.0
RECOVERY, ft.	13.7
RECOVERY, %	81

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
0	13	71	16
0	44	50	6
0	39	50	10

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A	R2A 0.4-2.8	Wet, dark gray, silty CLAY with some fine wood debris.	1
			2
			3
		Wet, black, fine to medium SAND.	4
			5
R3A	R3A 5.0-8.0	Wet, dark gray, fine sandy SILT.	6
			7
			8
R4A	R4A 8.0-12.0	Wet, dark gray, fine sandy SILT.	9
			10
			11
			12
R5A			13
			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

- Silty CLAY with wood debris.
- Fine to Medium SAND.
- Fine sandy SILT.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-3** Middle Waterway Phase 1A Sampling Stations CORE LOGS

MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	0.0
Water Depth	21.0
Mudline Elev.	-21.0

	Field	Lab
Date	5/11/98	5/12/98
Time	1143	1100

CORE LOCATION	MW027
DRIVE LENGTH, ft.	16.0
RECOVERY, ft.	12.0
RECOVERY, %	75

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
21	35	30	14
0	17	69	14
0	38	55	7

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description
R2A		Wet, black, clayey, organic SILT.
	R2A 1.0-3.8	Wet, black, clayey SILT with fine wood chips.
R3A	R3A 3.8-7.0	Wet, gray, fine sandy, SILT.
		Wet, gray to black, clayey SILT.
R4A	R4A .0-11.5	Wet, gray, fine sandy SILT. and layer of wet, gray SILT at 9.0 ft.
		Wet, black, fine SAND.

DEPTH: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

- Organic SILT.
- Clayey SILT with wood chips.
- Fine sandy SILT.
- Clayey SILT.
- Fine sandy SILT.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-4** Middle Waterway Phase 1A Sampling Stations CORE LOGS

MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	1.9
Water Depth	24.9
Mudline Elev.	-23.0

	Field	Lab
Date	5/8/98	5/11/98
Time	1135	1100

CORE LOCATION	MW028
DRIVE LENGTH, ft.	17.0
RECOVERY, ft.	14.3
RECOVERY, %	84

GRAIN SIZE in percent

GRAVEL	SAND	SILT	CLAY
1	78	19	3
1	88	9	2
0	30	59	11

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

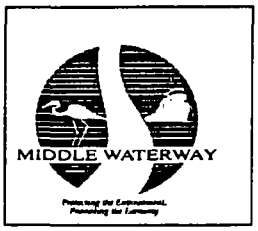
Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A		Wet, black, silty, sandy GRAVEL.	1
	R2A 0.3-2.5	Wet, black, silty, fine SAND.	2
			3
	R3A 2.5-6.0	Wet, black, fine to medium SAND with silt and red speckled material.	4
R3A			5
			6
			7
	R4A 6.0-10.0	Wet, black, fine sandy SILT.	8
R4A			9
			10
			11
	S5A	Wet, black, fine to medium SAND with silt and red speckled material.	12
R5A			13
			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

- Sandy GRAVEL
- Silty, fine SAND.
- Fine to medium SAND with silt.
- *Fine sandy SILT.*
- Fine to medium SAND with silt.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-5** Middle Waterway Phase 1A Sampling Stations CORE LOGS



MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	0.9
Water Depth	23.9
Mudline Elev.	-23.0

	Field	Lab
Date	5/12/98	5/14/98
Time	1335	930

CORE LOCATION	MW029
DRIVE LENGTH, ft.	17.0
RECOVERY, ft.	14.5
RECOVERY, %	85

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
0	74	23	3
0	49	44	7
0	65	28	4

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

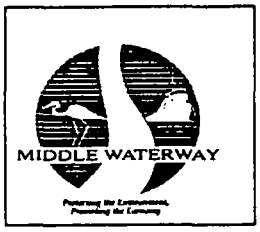
Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
		Wet, black, organic SILT.	1
		Wet, dark gray, clayey SILT.	2
R2A	R2A 1.2-4.0	Wet, gray, silty, fine SAND.	3
			4
			5
R3A	R3A 4.0-8.0	Wet, gray, fine sandy SILT.	6
			7
			8
			9
R4A	R4A .0-12.0	Wet, gray, silty, fine SAND. SILT with trace fine sand 9.5 to 10.5	10
			11
			12
			13
R5A			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

Organic SILT.
Clayey SILT.
Silty, fine SAND and Fine sandy SILT.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-6** Middle Waterway Phase 1A Sampling Stations CORE LOGS



MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	3.2
Water Depth	20.5
Mudline Elev.	-17.3

	Field	Lab
Date	5/11/98	5/12/98
Time	940	930

CORE LOCATION	MW030
DRIVE LENGTH, ft.	16.0
RECOVERY, ft.	10.8
RECOVERY, %	68

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
4	16	60	21
0	76	20	3

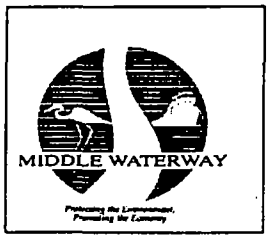
Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A		Wet, black, clayey SILT with chunks of wood at surface. Strong odor and oil sheen.	1
			2
		VOID with 2 gallons water from 1.4 to 4.0 feet.	3
	R2A 0.5-5.5		4
R3A		Wet, black, clayey SILT to silty CLAY with sand.	5
		Wet, black to dark gray, fine sandy, clayey SILT.	6
			7
	R3A 7.0-9.0	Wet, black, fine to medium SAND with silt and red speckled material.	8
R4A			9
			10
			11
			12
R5A			13
			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

- Clayey SILT with wood.
- Clayey SILT with sand.
- Fine sandy, clayey SILT.
- Fine to medium SAND with silt.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-7** Middle Waterway Phase 1A Sampling Stations CORE LOGS



MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	4.9
Water Depth	19.9
Mudline Elev.	-15.0

	Field	Lab
Date	5/8/98	5/11/98
Time	1304	1530

CORE LOCATION	MW031
DRIVE LENGTH, ft.	16.0
RECOVERY, ft.	10.0
RECOVERY, %	63

GRAIN SIZE in percent

GRAVEL	SAND	SILT	CLAY
15	54	24	8
2	46	41	11
1	86	12	2

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGHTS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A		Wet, black, *organic* SILT. *(very soft)*	1
			2
	R2A 1.7-4.0	Wet, black, silty, fine SAND. with mussel shells and calcium carbonate "honey-comb" material 3.5 to 4.0 feet.	3
			4
R3A	R3A 4.0-5.6	Wet, gray, fine sandy SILT.	5
			6
			7
	R4A 5.6-10.0	Wet, black, fine to medium SAND with silt and red speckled material.	8
			9
R4A			10
			11
			12
			13
			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

Organic SILT.

Silty, fine SAND with mussel shells.

Fine sandy SILT.

Fine to Medium SAND with silt.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-8** Middle Waterway Phase 1A Sampling Stations CORE LOGS

MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	0.8
Water Depth	11.8
Mudline Elev.	-11.2

	Field	Lab
Date	5/12/98	5/14/98
Time	1110	1200

CORE LOCATION	MW034
DRIVE LENGTH, ft.	16.0
RECOVERY, ft.	15.5
RECOVERY, %	97

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
3	53	37	7
0	50	44	5
0	67	29	4

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A	R2A 0.3-1.8	Wet, black to dark gray, silty fine SAND.	1
			2
	R3A 1.8-4.0	Wet, black, fine to medium SAND with silt and red speckled material.	3
		Wet, gray, fine sandy SILT.	4
R3A	R4A 4.0-7.0	Wet, gray, silty fine SAND.	5
			6
			7
		Less silty 7.0 to 8.0 feet.	8
R4A			9
			10
		Wet, gray, clayey SILT.	11
			12
R5A		Wet, black, fine to medium SAND with red speckled material.	13
			14
		Wet, gray SILT with fine sand. Silty CLAY 14.0 to 14.5 feet.	15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

- Silty, fine SAND.
- Fine to medium SAND.
- Fine, sandy SILT.
- Silty, fine SAND.
- Clayey SILT.
- Fine to medium SAND.
- SILT with fine sand.

Sampled by: Marine Sampling Service
Field Log by: Carol Hutley
Logged by: Mark Otten, P.E.

FOSTER WHEELER and HARTMAN CONSULTING CORPORATION

FIGURE A-9
Middle Waterway
Phase 1A Sampling Stations
CORE LOGS

MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	4.5
Water Depth	19.8
Mudline Elev.	-15.3

	Field	Lab
Date	5/12/98	5/14/98
Time	1520	830

CORE LOCATION	MW035
DRIVE LENGTH, ft.	17.0
RECOVERY, ft.	16.0
RECOVERY, %	94

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
2	67	25	6
0	34	58	8
0	47	48	5

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A	R2A 0.5-1.5	Wet, black, organic SILT.	1
		Wet, black, silty, fine SAND with wood debris & trace shells	2
			3
			4
R3A	R3A 1.5-8.0	Wet, gray, fine, sandy SILT.	5
			6
			7
			8
R4A	R4A 8.0-12.0 S4A	Wet, gray, silty, fine SAND to fine, sandy SILT.	9
			10
			11
			12
R5A			13
			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

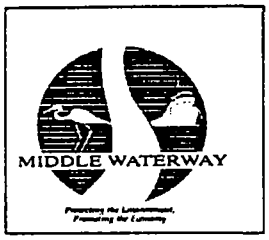
SUMMARY LOG BASED ON INSITU DEPTHS

Organic SILT.
Silty, fine SAND & wood debris.
Fine, sandy SILT.
Fine, sandy SILT

Sampled by:	Marine Sampling Service
Field Log by:	Carol Hutley
Logged by:	Mark Otten, P.E.

FOSTER WHEELER and HARTMAN CONSULTING CORPORATION

FIGURE A-10
Middle Waterway
Phase 1A Sampling Stations
CORE LOGS



MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	10.5
Water Depth	11.8
Mudline Elev.	-1.3

	Field	Lab
Date	5/11/98	5/13/98
Time	1718	930

CORE LOCATION	MW037
DRIVE LENGTH, ft.	16.5
RECOVERY, ft.	13.8
RECOVERY, %	84

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
3	87	8	2
0	69	26	5
0	66	29	5

DESCRIPTION OF CORE TUBES BASED ON TUBE LENGTHS

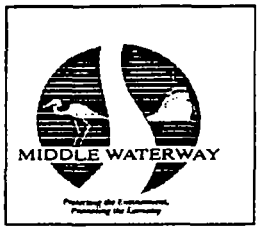
Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A		Wet, black, organic SILT with small shells.	1
			2
	R2A 1.0-4.7	Wet. black, *fine to medium* SAND with silt.	3
		Small wood debris 2.5 to 3.5 feet.	4
			5
R3A			6
	R3A 4.7-10.5	Wet, gray, silty fine SAND with scattered white shells.	7
			8
			9
R4A			10
			11
	R4A 10.5-12	Wet, black, silty, fine to medium SAND with red speckled material.	12
			13
			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG BASED ON INSITU DEPTHS

- Organic SILT.
- Fine to medium SAND.
- Silty, fine SAND.
- Silty SAND.

Sampled by: Marine Sampling Service Field Log by: Carol Hutley Logged by: Mark Otten, P.E.	FOSTER WHEELER and HARTMAN CONSULTING CORPORATION	**FIGURE A-11** Middle Waterway Phase 1A Sampling Stations CORE LOGS



MIDDLE WATERWAY PROBLEM WATERWAY
TACOMA, WASHINGTON

Tide Level	9.8
Water Depth	3.1
Mudline Elev.	6.7

	Field	Lab
Date	5/8/98	5/11/98
Time	1615	1615

CORE LOCATION	MW040
DRIVE LENGTH, ft.	14.0
RECOVERY, ft.	11.0
RECOVERY, %	79

GRAIN SIZE in percent			
GRAVEL	SAND	SILT	CLAY
2	57	36	5
0	40	53	7
1	88	9	2

DESCRIPTION OF CORE TUBES
BASED ON TUBE LENGTHS

Tube No. and Depth	Sample No. and Depth	Visual Sample Description	DEPTH
R2A		Wet, dark gray, silty, fine SAND. with wood bark.	1
		White shells and brick at 0.3 ft.	2
	R2A 1.2-3.5	Wet, dark gray, silty, fine SAND with fine wood debris.	3
			4
R3A	R3A 3.5-8.0	Wet, gray, fine, sandy SILT. with white shells.	5
			6
			7
			8
R4A	R4A 8.0-9.5	Wet, black, fine to medium SAND with silt and red speckled material.	9
			10
			11
			12
			13
			14
			15
			16
			17

NOTES
1. The stratigraphic contacts are generalizations based visual observations and laboratory test data. Variations between generalizations shown and actual conditions should be expected.
2. Grain size based on PSEP Method
3. Soil descriptions based on ASTM D-2488 Method.
4. See legend for interpretation notes.
5. Core tube logged is Replicate "A" at this station.

SUMMARY LOG
BASED ON INSITU DEPTHS

Silty, fine SAND.

Silty, fine SAND with fine wood debris.

Fine, sandy SILT with white shells.

Fine to medium SAND.

Sampled by: Marine Sampling Service
Field Log by: Carol Hutley
Logged by: Mark Otten, P.E.

FOSTER WHEELER
and HARTMAN CONSULTING CORPORATION

FIGURE A-12
Middle Waterway
Phase 1A Sampling Stations
CORE LOGS

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CEO

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GEOTECHNICAL ENGINEERING STUDY
PROPOSED REPLACEMENT WAREHOUSE
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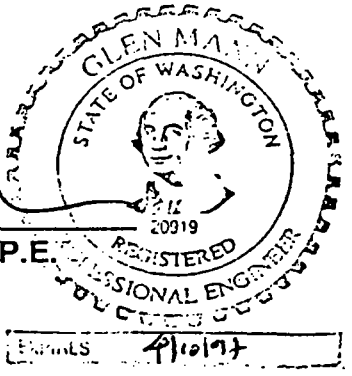
TACOMA, WASHINGTON



Glen Mann, P.E.
President

96-1703

September 5, 1996

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APPENDIX A

96-1703

Field Exploration Program

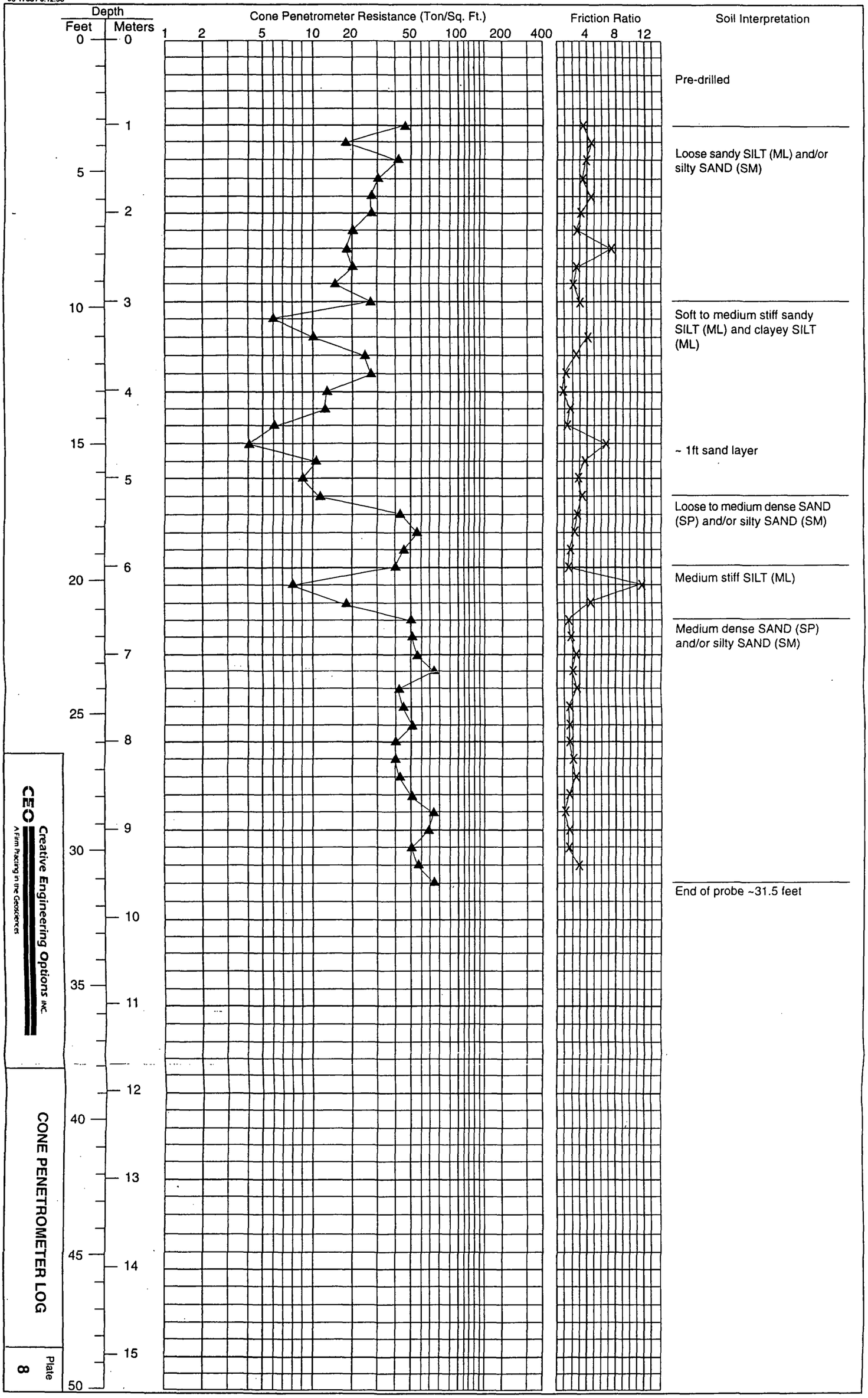
Our field exploration was performed on July 29, 1996. The subsurface conditions were explored by hydraulically inserting two exploratory Dutch Cone Probes to a maximum depth of approximately forty-five and one half (45-1/2) feet below the existing surface at the approximate locations shown on Plate 2, Site Plan. The probes were inserted with a rubber tired, truck mounted, drill provided and operated by our subcontractor, Subterranean of Milton, Washington.

The approximate Dutch Cone Probe locations were determined by pacing from the northwestern corner peg for the new structure. The Dutch Cone elevations were approximately determined by interpolation between contour lines shown on an untitled and undated section of a site topographic plan provided by the civil engineer, Sitts & Hill Engineers. The locations and elevations of the Probes should be considered accurate only to the degree implied by the methods used.

The field exploration was continuously monitored by an engineer from our firm who maintained a log of each probe. Our representative recorded the cone resistance and friction ratio as the probes were incrementally inserted into the ground. He subsequently interpreted the nature and classification of the penetrated soils. The soils were classified in general accordance with the Unified Soil Classification System (USCS).

The number and approximate location of each of the Dutch Cone Probes are shown on the Site Plan, Plate 2. Individual logs of the Probes are presented on Plates 8 and 9. The final logs represent our interpretation of the field logs. The stratification lines on the logs represent the approximate boundary between soil types. In actuality, the transition may be more gradual or more severe.

96-1703 / 8.12.96



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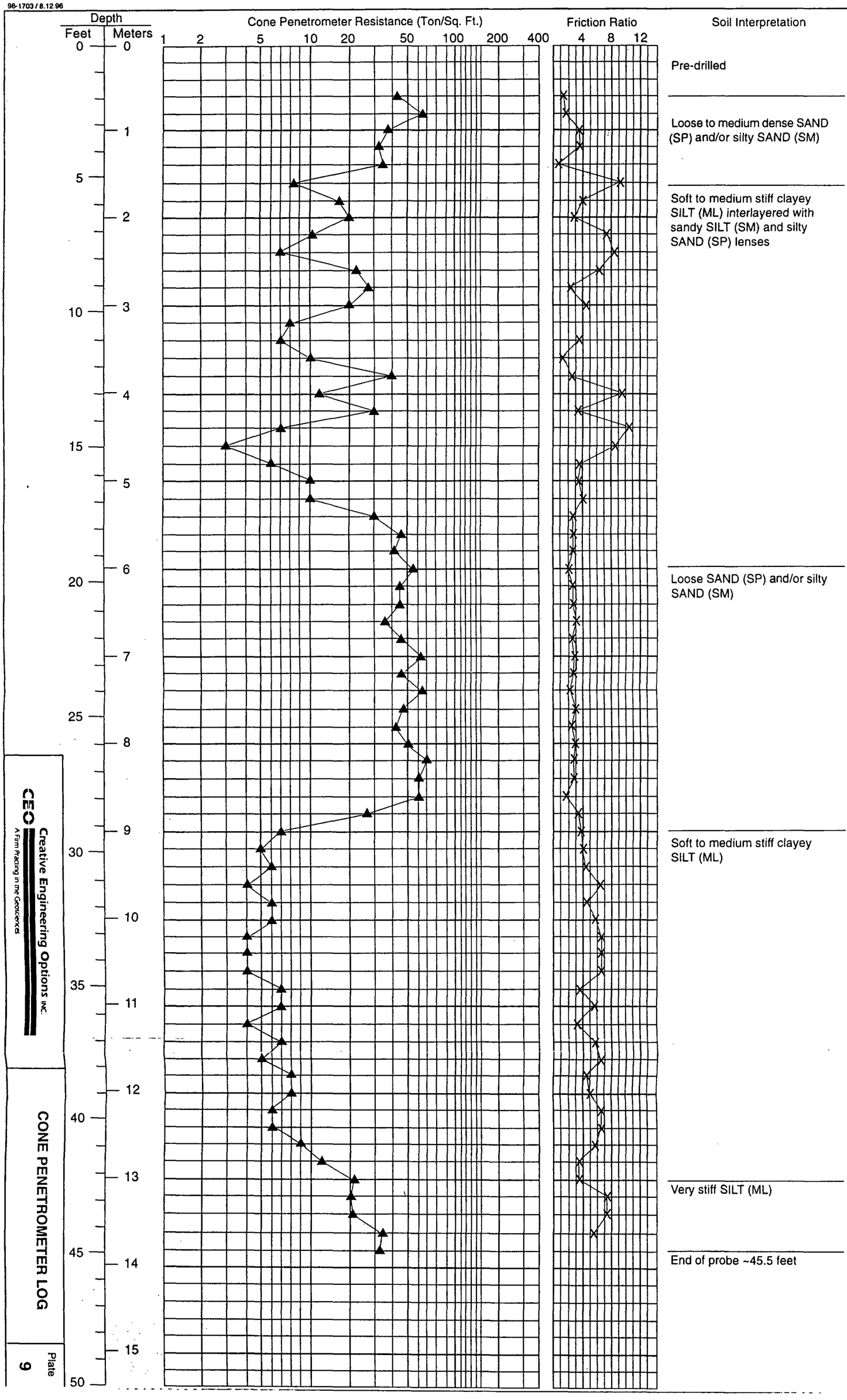
CONE PENETROMETER LOG

Plate 8

96-1703 / 8.12.96



Soil Interpretation

Pre-drilled

Loose to medium dense SAND (SP) and/or silty SAND (SM)

Soft to medium stiff clayey SILT (ML) *interlayered* with sandy SILT (SM) and silty SAND (SP) lenses

Loose SAND (SP) and/or silty SAND (SM)

Soft to medium stiff clayey SILT (ML)

Very stiff SILT (ML)

End of probe ~45.5 feet

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CONE PENETROMETER LOG

Plate 9

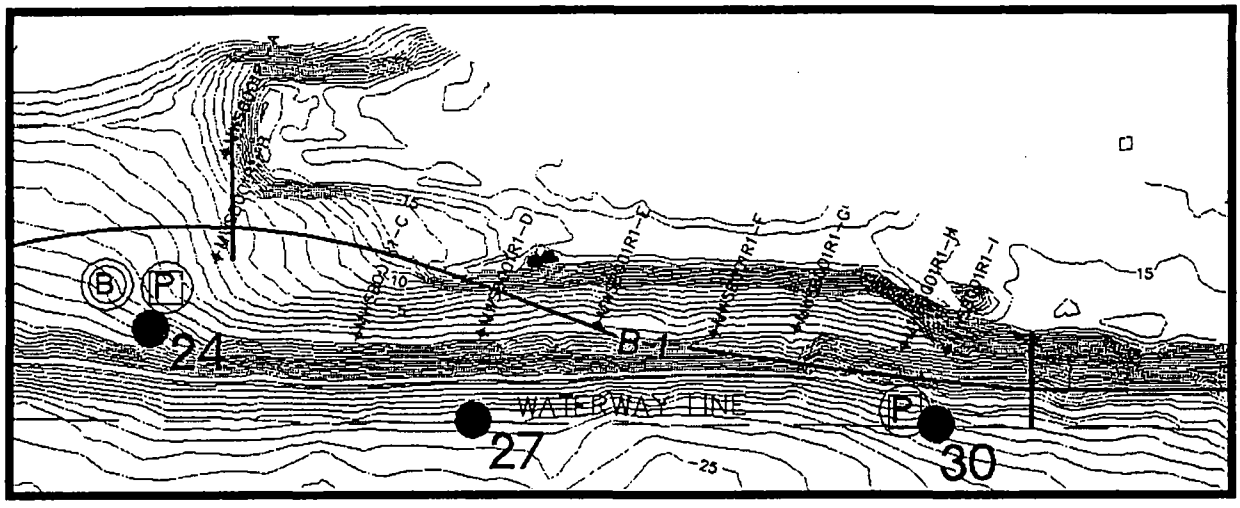
APPENDIX B

WATERWAY BANK SEGMENT SAMPLING SUMMARY FORMS

Waterway Bank Segment Sampling Summary - (B-1)

Sample ID:	**B-1** (MWSB001R1)	Sample Method:	Hand
No. of Discrete Samples:	9	Spacing Interval:	~50'
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	8	Parallel to end of rip rap wall north ± 35'
B	4	Midway along line from stake at rip rap corner to outward dolphin
C	0	Near 4th pier (dolphin) in from end ± 10 feet south of north end of concrete rip rap
D	0	Midway between 5th & 6th dolphin ± 25 feet from base of rip rap (Discrete)
E	0	Midway between 6th & 7th dolphins
F	-1	9th dolphin black/sandy rocks on top
G	-.5	10th dolphin. Black (H_2S smell) sheen
H	-.5	Past 11th dolphin ± 10 black/rocks
I	0	50 feet north of old pier area (group of 14-16 pilings) some sheen

Comments: Volatile and sulfide collected at (discrete) only.

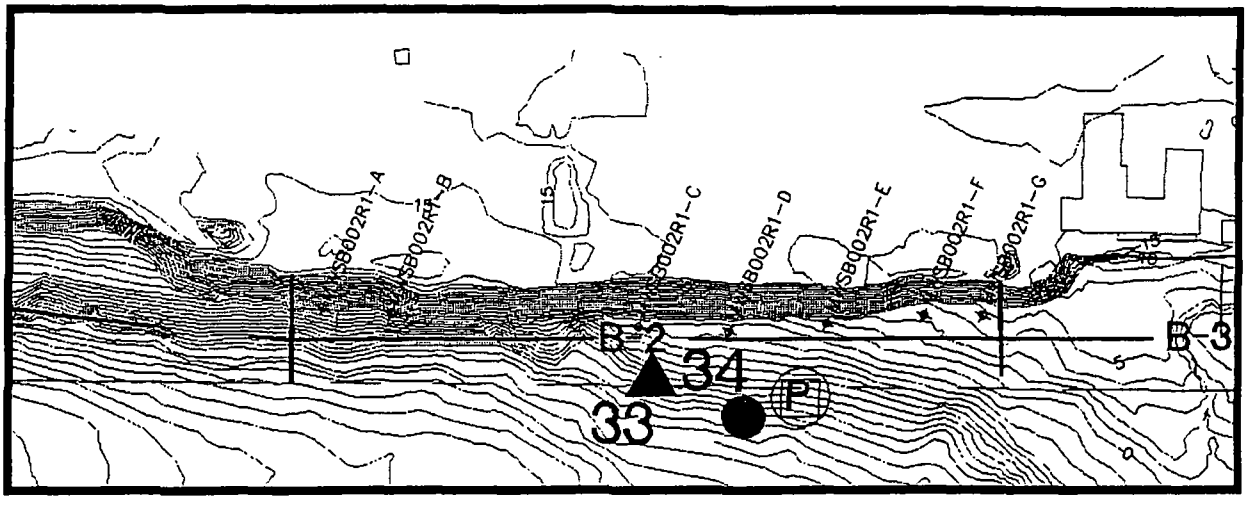
Total Sample Volume: Approximately 4L Sampled by: EW

Date/Time Sampled: 13:15 05/28/98

Waterway Bank Segment Segment Sampling Summary - (B-2)

Sample ID:	**B-2** (MWSB002R1)	Sample Method:	Hand
No. of Discrete Samples:	7	Spacing Interval:	~50'
Sample Type:	*Surface*		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	0	30 feet south of north boundary stake 2' east of piers (center group in cluster)
B	0	50 feet south; coarse with sheen
C	-1	200 feet south at end of rocky rip rap area (discrete)
D	-1	50 feet south; black under brown shells
E	2	50 feet south; olive top (1/2 cm) dark brown below
F	3.5	50 feet south; brown
G	5	35 feet south; black under olive

Comments: Volatile and sulfide collected at (discrete) only.

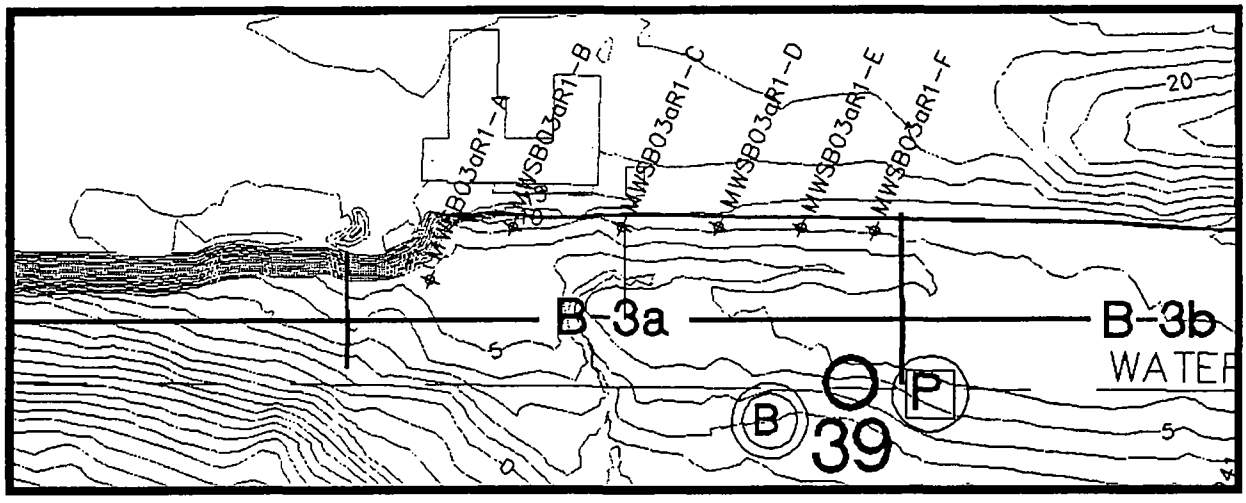
Total Sample Volume: Approximately 4L Sampled by: EW

Date/Time Sampled: 13:30 05/28/98

Waterway Bank Segment Sampling Summary - (B-3a)

Sample ID:	**B-3a** (MWSB03aR1)	Sample Method:	Hand
No. of Discrete Samples:	6	Spacing Interval:	~50'
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	5.5	35 feet south of north boundary; black under soft olive layer
B	7	45 feet south grey/brown
C	7	50 feet south; EPA location for composite portion black with red brick
D	7	50 feet south brown (discrete)
E	7	50 feet south black; wood
F	7	40 feet south; 10' north of south boundary

Comments: Volatile and sulfide collected at (discrete) only.

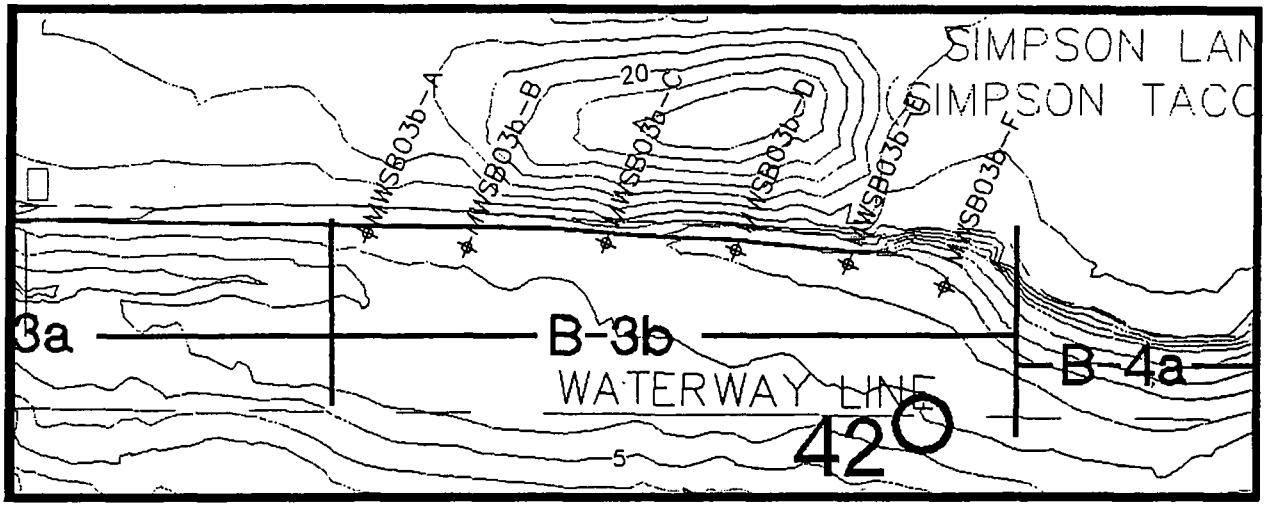
Total Sample Volume: Approximately 4L Sampled by: EW

Date/Time Sampled: 14:20 05/28/98

Waterway Bank Segment Sampling Summary - (B-3b)

Sample ID:	**B 3b** (MWSB03b)	Sample Method:	Hand
No. of Discrete Samples:	6	Spacing Interval:	~50'
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	7	20 feet south from north boundary; brown
B	7	50 feet south; red sheen (from bacteria?)
C	8	50 feet south; base of slope below rip rap; brown
D	8	50 feet south; dark brown/ black (Discrete)
E	8	50 feet south; base of slope; top of rip rap; wood
F	9	20 feet from south boundary; olive top/black below

Comments: Volatile and sulfide collected at (discrete) only.

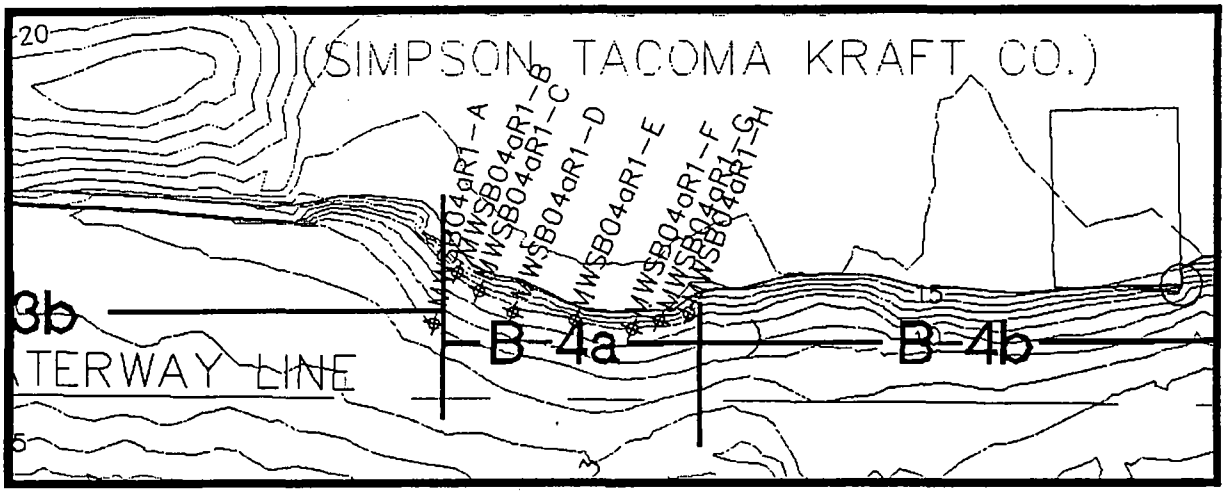
Total Sample Volume: Approximately 4L Sampled by: EW

Date/Time Sampled: 15:00 05/28/98

Waterway Bank Segment Sampling Summary - (B-4a)

Sample ID:	**B-4a** (MWSB04aR1)	Sample Method:	Hand
No. of Discrete Samples:	8	Spacing Interval:	~25'
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	9	At north stake 30' from bottom of vertical bank
B	13	Same location 5' from foot of vertical bank
C	12	25 feet south 10' from base of vertical bank.
D	11.5	25 feet south 10' from base of vertical wall
E	12	25 feet south - 12' off vertical fence black
F	12	30 feet south - 20' off vertical face brown/black with sheen
G	13	5 feet north of south boundary 5' below vertical face (wood in face here)
H	13	On south boundary black sheen

Comments: Volatile and sulfide collected at (discrete) only.

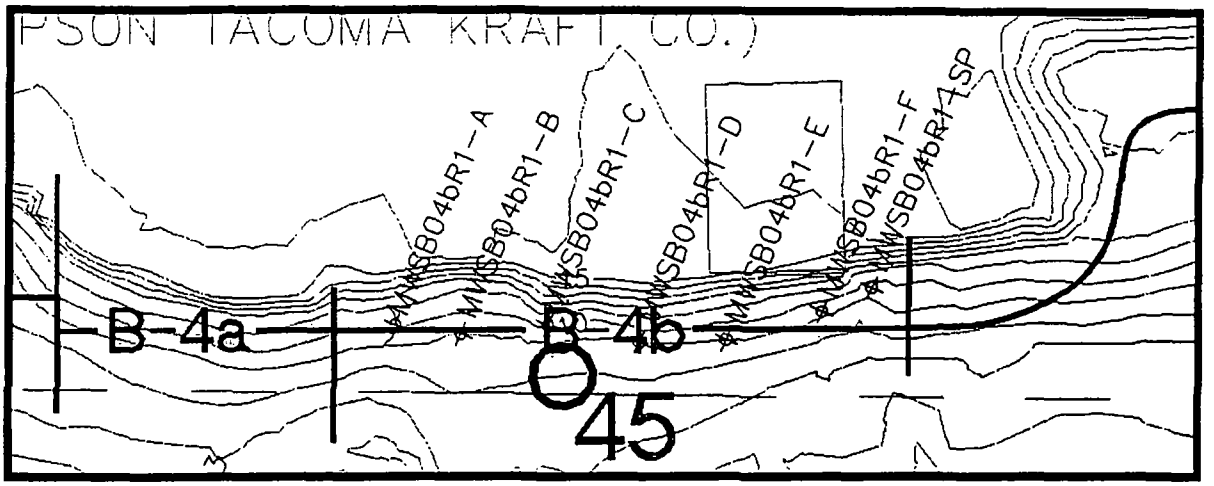
Total Sample Volume: Approximately 4L Sampled by: EW

Date/Time Sampled: 15:22 05/28/98

Waterway Bank Segment Sampling Summary - (B-4b)

Sample ID:	**B-4b** (MWSB04bR1 & MWSB04bR1SP)	Sample Method:	Hand
No. of Discrete Samples:	6	Spacing Interval:	~40'
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	10	10 feet south from north boundary 20' below vertical
B	9	40 feet south 10' below wet face; sheen red/brown to black
C	10	40 feet south 20' below wet face @ slope break (wood) black
D	9	40 feet south 15' below wet face seepy area below old "inactive" pipe; (black)
E	9	40 feet south black; very soft
F	9	60 feet south, 15' north of south boundary; black soft
SP	9.5	60 feet south, 15' north of south boundary; black soft

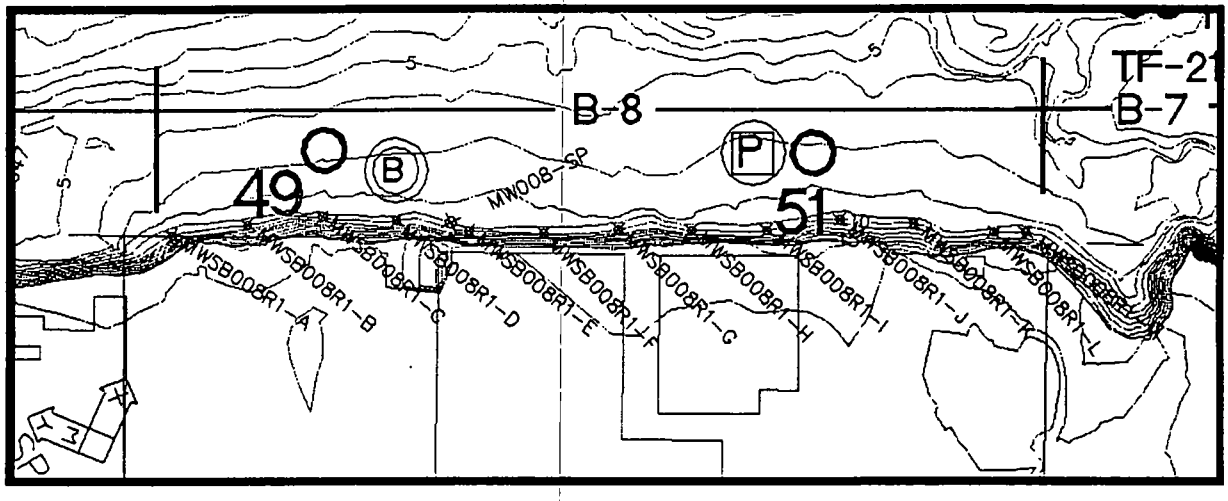
Comments: Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	Approximately 4L	Sampled by: EW	
Date/Time Sampled:	15:27 05/28/98	Photos: Roll No. 5	Photo No. 18
		Special 4b 5	19

Waterway Bank Segment Sampling Summary - (B-8)

Sample ID:	**B-8** (MWSB008R1 & 008S1 MWSB008R1SP)	Sample Method:	Hand
No. of Discrete Samples:	13	Spacing Interval:	~50'
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	10	North end up the bank 10' from flag pt. - wood debris
B	10	50' south brown with black below
C	10	50' south brown with black below
D	10	50' south ~20' from fence with razor wire black
E	9	50' s just south of roofing material (Discrete)
F	10	50' sandy
G	10	50' south between Mylet buildings at base of slope; red brick
H	10	50' south at DNR stake
I	10	50' south end Mylet building - brown/black/red brown
J	10	50' Dark brown
K	10	Below shed at south end Mylet - black, (Oyster shells laying around)
L	10	South end segment brown/black with underlying red or red brown; glass below surfa

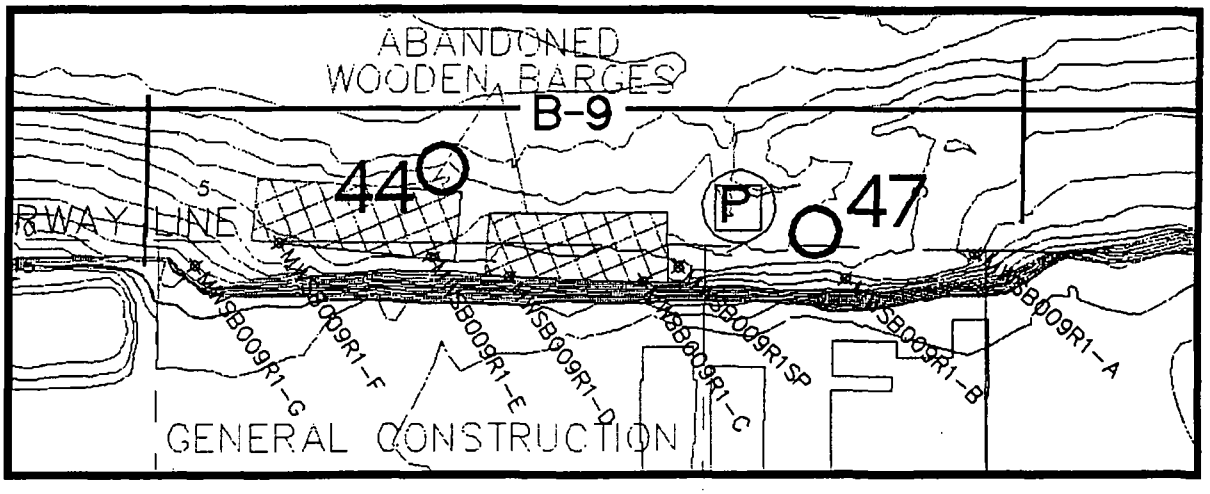
Comments: Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	Approximately 4L	Sampled by: EW	
Date/Time Sampled:	05/27/98 16:20		
	SP 05/28/98 10:30	Photos: Roll No. 5 (SP)	Photo No. 12(SP)

Waterway Bank Segment Sampling Summary - (B-9)

Sample ID:	**B-9** (MWSB009R1 & MWSB009R1SP)	Sample Method:	Hand
No. of Discrete Samples:	7/1	Spacing Interval:	± 50 ft.
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	7	End of rip rap at south end of segment 30' from stake.
B	7.5	Between old green warehouse next to GC property - near old winch (wood/mulch)
C	6	Near south end of south barge (brown/black/ red at depth)
D	6	15 feet south of north end south barge, black shallow olive layer
E	5	15 feet north of south end north barge, olive top black under soft
F	5	± 15 feet south of north end north barge black under olive top; soft
G	9	± 20 feet south of north boundary black below olive top, sand/ silty

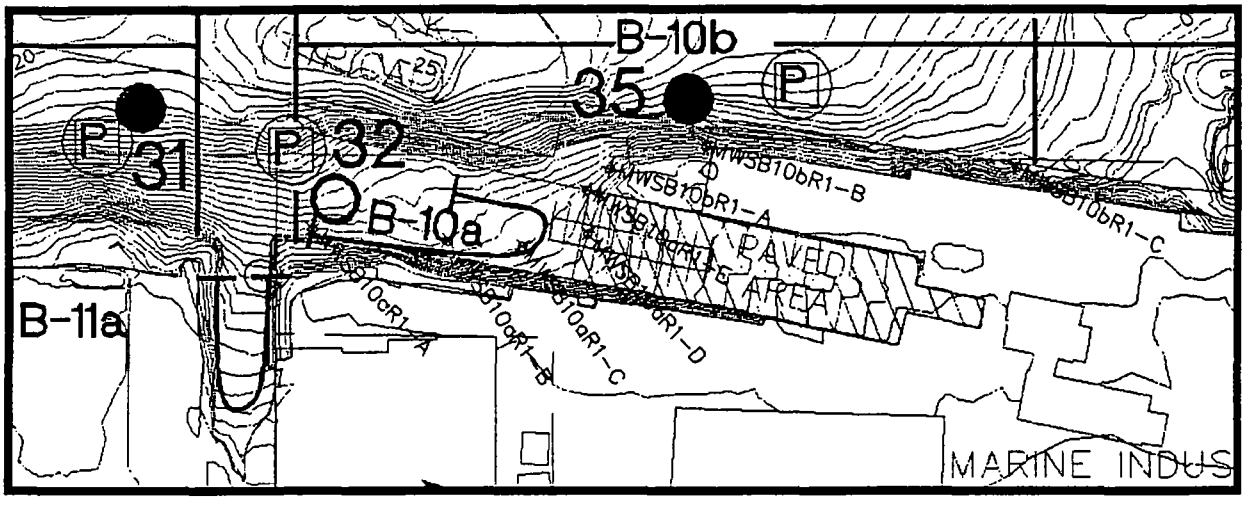
Comments: Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	Approximately 4L each	Sampled by: EW	
Date/Time Sampled:	10:51 05/28/98	Photos: Roll No. 5	Photo No. 13

Waterway Bank Segment Sampling Summary - (B-10a & B-10b)

Sample ID:	**B-10a&b** (MWSB10aR1 and 10bR1)	Sample Method:	Hand
No. of Discrete Samples:	5(10a)/3(10b)	Spacing Interval:	As available
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete at 4 for 10a / at 2 for 10b

Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
10a		
A	0	10-12' south of boat ramp 1 & 1/2' from base of wall; brown
B	0	At south end of ship way near base of rip rap; brown
C	2	Halfway between 10aR1-B and ship rails; black
D	4	Between ship rails; black
E	2	Opposite side of tracks along pier; brown/black
10b		
A	2	North end of segment - middle of pier; brown
B	0	30' South along shoreline - near seep; brown, soft
C	0	Near south end of segment; brown, soft

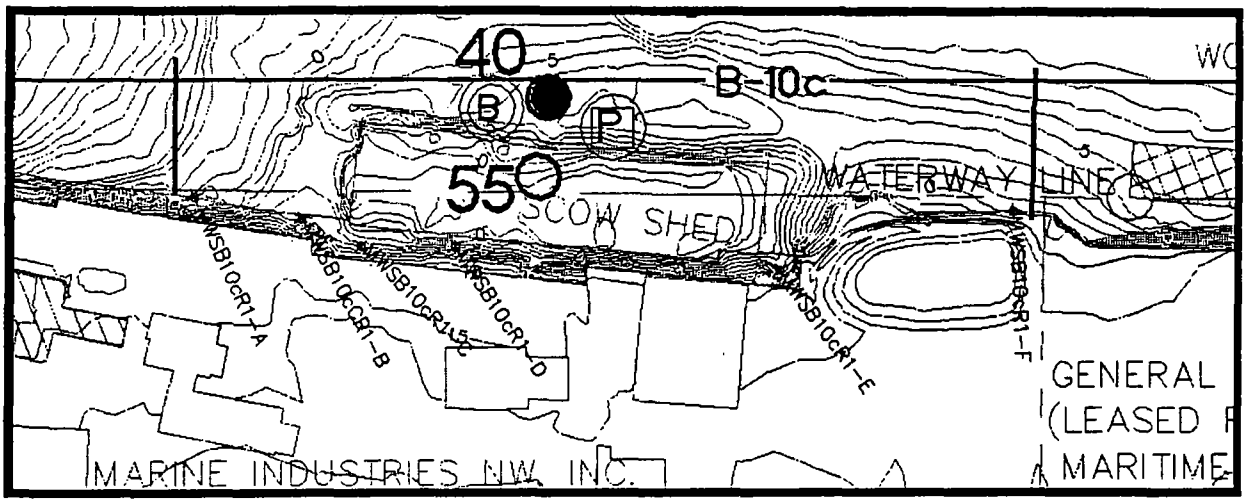
Comments: Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	Approximately 4L	Sampled by: EW	
Date/Time Sampled:	05/27/98 10a 13:55 10b 14.:13	Photos: Roll No. 5	Photo No. 7,8,9

Waterway Bank Segment Sampling Summary (B-10c)

Sample ID:	**B-10c** (MWSB10cR1)	Sample Method:	Hand
No. of Discrete Samples:	6	Spacing Interval:	As available
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	-1	North end ~10 feet from stake ~3' from waterline 1 1/2' inside outer pier
B	5	50' south ~10' south of access ladder
C	5	50 ' south area entrance to Scow shed
D	3	60' south across from 5th pier on outside of shed (Discrete)
E	3	South end of shed in corner
F	10	~20-30' from south boundary stake

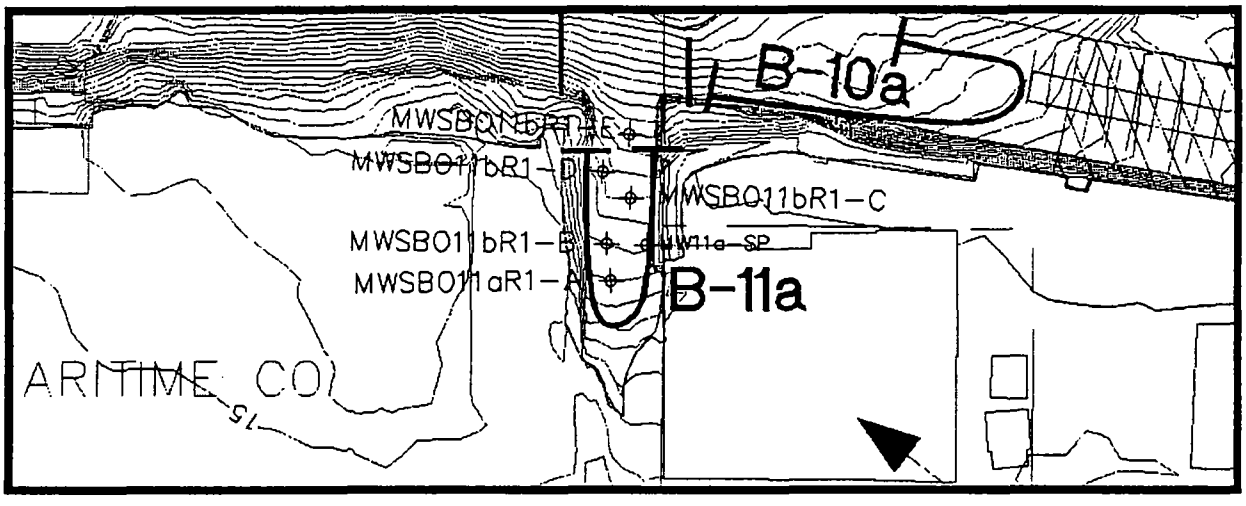
Comments: Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	4L	Sampled by: EW	
Date/Time Sampled:	05/27/98 14:30	Photos: Roll No. 5	Photo No. 10

Waterway Bank Segment Sampling Summary (B-11a)

Sample ID:	**B-11a** (MWSB11aR1 & MWSB11aR1-SP)	Sample Method:	Hand
No. of Discrete Samples:	5	Spacing Interval:	Random
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A B C	10 9 7	Randomly placed side to side along the length of the boat ramp. Upper areas were dark brown. Areas close to the water were brown with black below. All samples were sandy with those near the water having a finer grain and being softer.
D E SP	7 4 9	

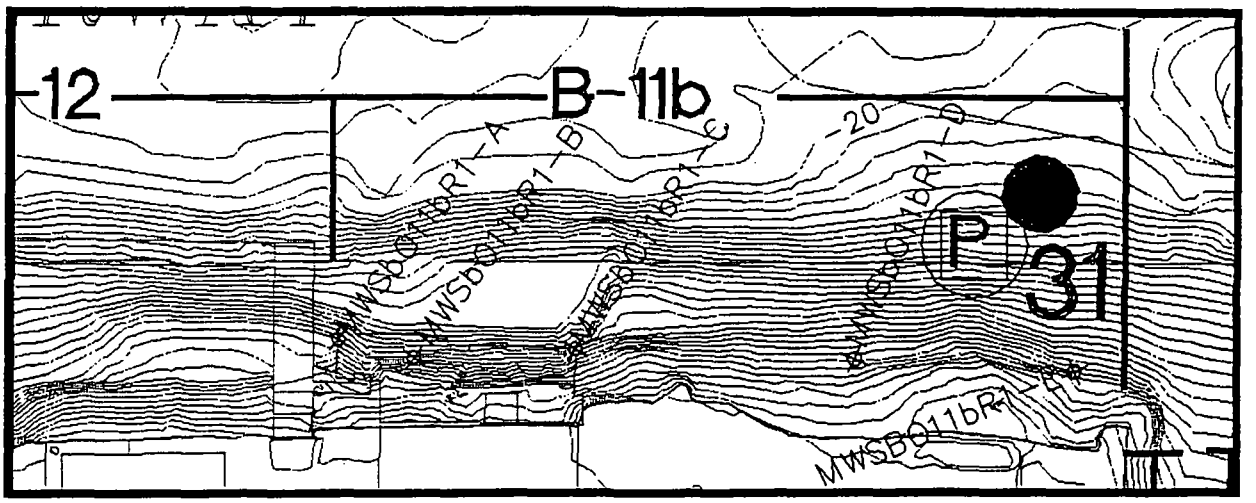
Comments: Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	4L	Sampled by:	EW
Date/Time Sampled:	13:30 05/27/98		

Waterway Bank Segment Sampling Summary - (B-11b)

Sample ID:	**B-11b** (MWSB11bR1)	Sample Method:	Hand
No. of Discrete Samples:	5	Spacing Interval:	As available
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	0	Northend of abandoned dock 2' off top of slope within seep area ~10' south of Foss dock
B	0	~35 Feet south along shore
C	0	South end of abandoned dock below rip rap black (Discrete except volatiles)
D	6	Midway between Foss dock and shipway boat launch
E	6	Approximately 20' north of boat launch. No sampling sites between Foss dock and site D due to rip rap and debris. Limited sampling sites under Foss dock. Volatiles taken at last station (Volatiles)

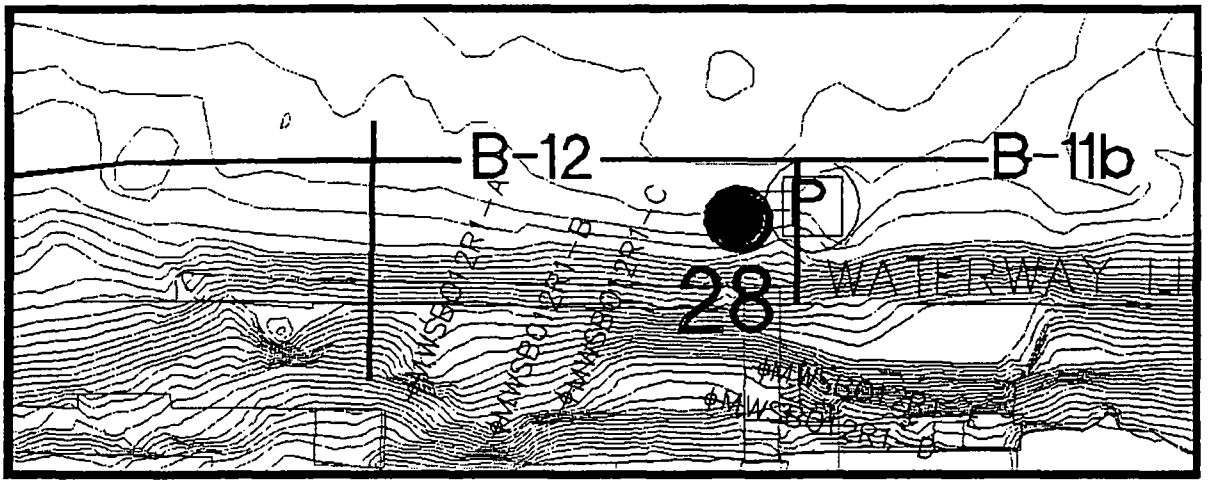
Comments: Volatile and sulfide collected at (discrete) only. Locations A & B are just inside the outer limit of the old dock.

Total Sample Volume:	4L	Sampled by:		
Date/Time Sampled:	13:05 05/27/98	Photos: Roll No. 5	Photo No.	4,5

Waterway Bank Segment Sampling Summary - (B-12)

Sample ID:	**B-12** (MWSB012R1)	Sample Method:	Hand
No. of Discrete Samples:	4 sub samples	Spacing Interval:	As available
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	0	20' from pier area at south end of old shipyard building brown shell. Even with last pier at top of bank holding up Foss parking area 3 feet
B	1	from base of rip rap brown/black
C	0	Even with 3rd dolphin on floating dock 5' from base of rip rap. Dark brown (Discrete)
D	4	Even with south face of Foss Building 8' from top of slope in area where sediment is present Dark brown
E	1	Between 2nd and 3rd set of piers under Foss dock, black with olive top.

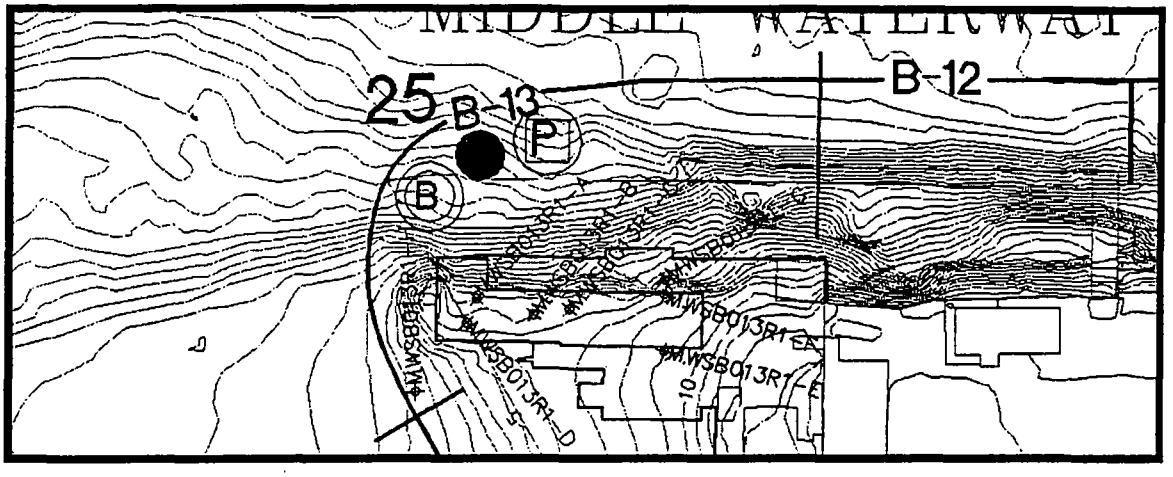
Comments: Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	Approximately 4L	Sampled by: EW	
Date/Time Sampled:	12:50 05/27/98	Photos: Roll No. 5	Photo No. 1-2

Waterway Bank Segment Sampling Summary - (B-13)

Sample ID:	**B-13** (MWSB013R1)	Sample Method:	Hand
No. of Discrete Samples:	7	Spacing Interval:	Random
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A B C	4 5 5.5	See descriptions of locations in log book. Sampled at random locations under the old shipyard building
D E F	5.5 9 7	
G H	6 0.5	

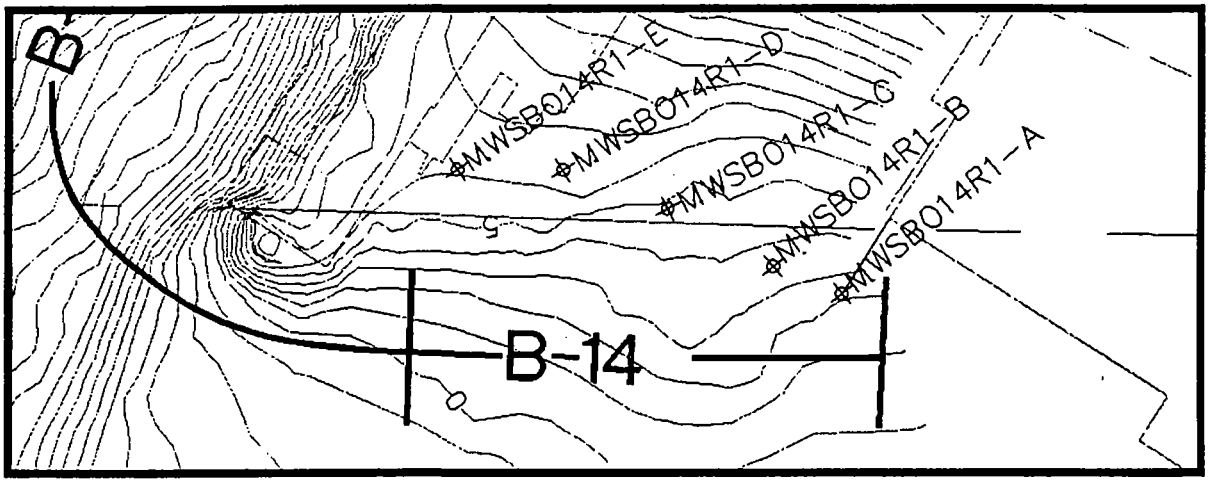
Comments:Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	Approximately 4L	Sampled by: EW	
Date/Time Sampled:	11:40 05/27/98	Photos: Roll No. 4	Photo No. 19-23

Waterway Bank Segment Sampling Summary (B-14)

Sample ID:	**B-14** (MWSB014R1)	Sample Method:	Spoon
No. of Discrete Samples:	5 sub sections	Spacing Interval:	~50'
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A B C	2 3.5 5	Subsections followed seep line along slope break lined up with third column from top of log chute on abandoned shipyard building (Discrete at C)
D E	6.5 6	Near face of abandoned ship rail following along seep line. Closer to the water due to curve of beach area.

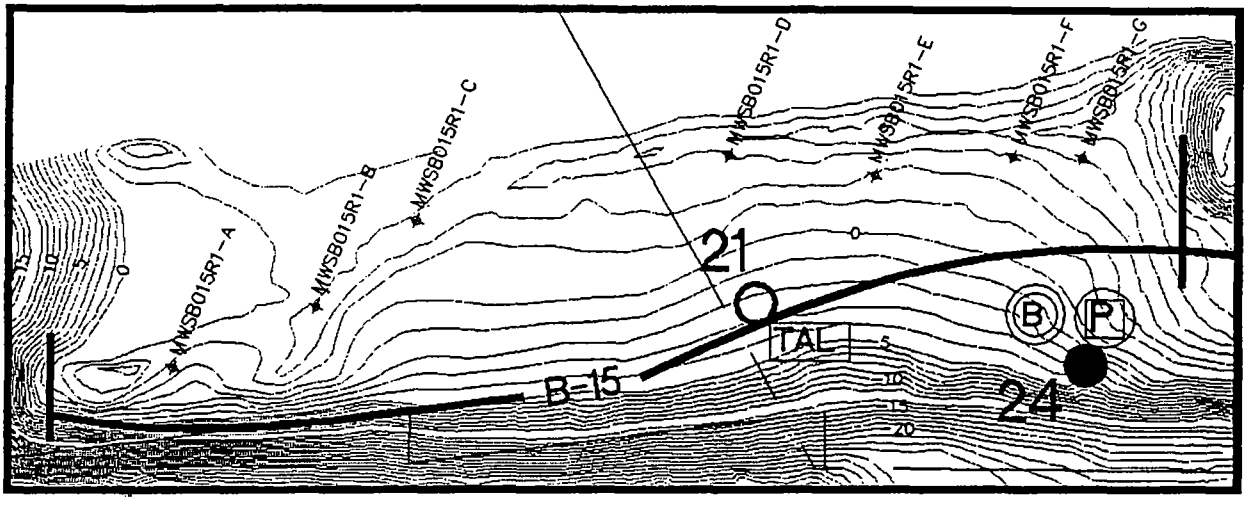
Comments:Volatile and sulfide collected at (discrete) only.

Total Sample Volume:	Approximately 4L	Sampled by: EW	
Date/Time Sampled:	11:20 05/27/98	Photos: Roll No. 4	Photo No. 19/20

Waterway Bank Segment Sampling Summary (B-15)

Sample ID:	B-15 (MWSB0015R1)	Sample Method:	Hand
No. of Discrete Samples:	7	Spacing Interval:	As available
Sample Type:	Surface		
Sample Depth:	0-10 cm		

Waterway Bank Segment Plan



Discrete Sample Location Description

Discrete Sample Identifier	Approximate Elevation	Field Location Description
A	0	50 feet south of north end of spit
B	2	75 feet south; shells & wood
C	2	Near fork in shell deposition pattern just north of spot where center pier disappear
D	3	75 north of large rock pile (Discrete)
E	2	At pile of rocks; 20 feet west
F	3	Halfway between rock pile and shoreline (wood)
G	4	At base of shoreline - seep area

Comments: Volatile and sulfide collected at (discrete)only.

Total Sample Volume: Sampled by:

Date/Time Sampled: 12:40 05/28/98 Photos: Roll No. 5 Photo No. 14

APPENDIX C

RESPONSE TO EPA COMMENTS

Response to EPA Comments
Middle Waterway Round 1B Technical Memorandum

A Revised Final Pre-Design Deliverable Round 1B Technical Memorandum (Tech Memo) dated December 10, 1998 was submitted in compliance with Section VIII of the Administrative Order on Consent (AOC) for the Middle Waterway Problem Area of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site.

The Revised Tech Memo was based on EPA's November 19, 1998 comments (Attachment 1) on the September 18, 1998 Round 1B Technical Memorandum. Because the document was substantially revised to address EPA comments and requests for data evaluation, a redline version proved to be illegible. Upon review of EPA's comments, MWAC requested an extension until January 18, 1999 for submittal of the Revised Tech Memo (Attachment 2). EPA denied this extension request on December 2, 1998 (Attachment 3).

On July 9, 1999, EPA provided MWAC comments on the December 10, 1998 Revised Tech Memo. Based on these comments, MWAC has prepared a Final Tech Memo dated August 23, 1999 which is submitted in compliance with Section VIII of the AOC.

This appendix provides a response to each of EPA's November 19, 1998 specific comments (Attachment 1) on the Draft Tech Memo (Attachment 4) and EPA's July 9, 1999 comments (Attachment 5) on the Revised Final Tech Memo (Attachment 6). The cover letter to EPA's November 19, 1998 and July 9, 1999 comment letters also included a general discussion of issues that MWAC believes are addressed in our specific responses and in the Final Tech Memo. Nonetheless, these general comments are reiterated in the introduction to Attachment 6, followed by MWAC's response in italic print.

Attachment 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

November 19, 1998
SENT BY CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Reply To
Attn Of: ECL-115

Kim Maree Johannessen
Johannessen & Associates, P.S.
5413 Meridian Avenue North, Suite C
Seattle, WA 98103-6138

David Templeton, Program Manager
Foster Wheeler Environmental Corporation
10900 NE 8th Street, Suite 1300
Bellevue, WA 98004-4405

Re: EPA comments on DRAFT Round 1B Technical Memorandum (September 28, 1998)

Dear Ms. Johannessen and Mr. Templeton:

The U.S. Environmental Protection Agency (EPA) has reviewed the draft Technical Memorandum referenced above, and provides comments to be addressed in this letter and attached EPA comments. Also enclosed are copies of letters received from Natural Resource Trustees who commented on the document.

The Technical Memorandum provides tables and figures which present data collected this spring. In addition, the document briefly discusses data gaps to be filled and proposed Round 1B sampling to fill these gaps, with a supporting figure and table of sample locations and analytical parameters.

As we have discussed in previous meetings, the document presents limited data evaluation or rationale supporting the data gap interpretation and proposed sampling. Additional discussion and figures showing the distribution of individual or related groups of contaminants would aid interpretation of the results. It may be argued that such details are intended for later inclusion in the Pre-Design Data Evaluation Report, but the Middle Waterway Statement of Work states:

> The Round 1B Technical Memorandum will identify and provide a basis for additional data collection needs...[and]...include a preliminary discussion of the Round 1A sampling...and will provide an estimate of the volumes of sediment which may require active remediation. In addition, it will identify data gaps, if any, to accomplish the objectives of the AOC and this SOW..."

Since the Round 1B sampling is intended to conclude all necessary testing to support remedial design, it is important to indicate how each of the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling. At this point, it is unclear that all objectives will be met, as discussed below.

For example, EPA believes that the proposed sampling does not provide enough lateral or vertical characterization to support remedial design volume estimates for potential remediation areas at the waterway head and potential source areas on banks, to support a demonstration of whether natural recovery is possible or preferable as part of the waterway remediation plan, or to assess the potential for recontamination from bank sources. In addition, contaminant mobility information for sediments which may be dredged at the head, or a demonstration that existing information is sufficient is necessary.

The proposed sampling plan eliminated analyses for a number of contaminants (such as metals other than mercury, and organics other than PAHs, such as PCBs, certain pesticides, tributyltin (TBT), and furans) in a number of locations, with no rationale. EPA is not willing to rely on indicator contaminants and eliminate other SQO contaminants from analysis unless the contaminant has never exceeded the Sediment Quality Objectives (SQO) in any previous waterway sampling or unless MWAC can demonstrate on a station by station basis to EPA's satisfaction that adequate information has already been obtained. We have already discussed many of the sample locations, and EPA has stated that SQO metals and PAHs are generally necessary at a minimum, and that samples in the vicinity of previous SQO exceedances for other chemicals must address those analytes. Please note that additional data should help in defining cleanup areas and volumes and in reducing the uncertainties of post-cleanup testing.

In order to avoid a third round of sampling, EPA is also open to discussing tiered analysis of archived surface and subsurface samples. Archiving may reduce or eliminate data gaps if the results at the proposed sampling locations for surface sediment chemistry turn out to exceed SQOs.

Biological sampling proposed in the Round 1B Tech Memo does not include benthic sampling or any chronic measure, and is proposed at a limited number of locations without a supporting rationale. In presenting proposed sample locations, it would be helpful to present the rationale for the locations included and omitted. Also, as we have discussed, EPA believes that the Round 1A reference benthic stations were suitable and that benthic data from Round 1A are usable. Additional biological stations should include benthic infaunal analysis. In addition to potentially overriding chemical SQO exceedances, this information may support overall assessments of habitat. Rejection of the Round 1A benthic data would mean that Round 1A benthic locations would have to be resampled.

Further discussion should be provided in the report regarding whether the existing and proposed data will support an assessment of the potential for recontamination. Clearly, the proposed bank sampling is intended to assess sources in areas with high mercury concentrations on Foss property banks. However, a systematic discussion is needed (property by property, or

area by area, for example) indicating how permitted discharges (at Marine Industries Northwest, Inc. and MI-200), unpermitted smaller outfalls, banks, and other potential sources have been (or will be in Round 1B) adequately characterized for purposes of assessing potential recontamination. Recontamination from subsurface areas should also be considered. Please note that the Washington Department of Ecology (Ecology) Milestone Reports 3 and 4 have been completed for Middle Waterway. MWAC may find Hylebos reports on the potential for recontamination useful in considering what kind of assessment EPA anticipates in future (and, thus, what kind of data may be needed from Rounds 1A and 1B to support the assessment).

As you are aware, EPA has been working with the City of Tacoma on further characterization of dioxins in sediments in and near the Olympic View Resource Area. To assess whether dioxins are found at elevated levels within Middle Waterway, we would like MWAC to collect samples near the former Coast Craft facility, which was identified as a potential source of dioxins in a recent Ecology report.

EPA acknowledges that the timing for Round 1B sampling may pose problems for bioassays. Bioassays conducted at this time of year often result in ambiguous data due to reference mortalities. EPA would consider a two-phase sampling approach in the next submittal of Tech Memo 1B, which would call for as much field work as possible this fall, but would allow for biological testing in early spring.

MWAC has seen a draft copy of these comments, and EPA has had several opportunities to discuss options with MWAC in technical meetings. I would like to propose that MWAC now prepare a revised proposal by providing an updated Figure 14, Table 15, and phasing schedule for discussion by December 1. The figure would be a focal point for discussion at a meeting during the week of November 30, and rationales could be provided verbally in anticipation of including them in the revised Tech Memo.

As you know, the Scope of Work calls for resubmittal of the revised Tech Memo 15 days from receipt of EPA comments. By this letter, I am extending this timeframe to **20** days from receipt of EPA comments. Please contact me if you have any questions. I can be reached at (206) 553-1215.

Sincerely,

Ellen Hale
Site Manager

cc: Tod Gold - EPA/ORC
Russ McMillan - Ecology
Allison Reak - Roy F. Weston
Chris Beaverson - NOAA (EPA)

EPA TECHNICAL REVIEW

MIDDLE WATERWAY ROUND 1B TECHNICAL MEMORANDUM

A technical review of the Round 1B Technical Memorandum (tech memo), including the Preliminary Estimates of Dredge Volume and Contaminant Mobility Test Results in Support of Combined Disposal (Appendix C), prepared by Foster Wheeler (1998a), was conducted by Roy F. Weston, Inc. (WESTON). The purpose of the review was to evaluate the (1) completeness of the key elements, compared to the Statement of Work (SOW) (USEPA 1996); (2) rationale, justifications, and conclusions of the report and report elements; (3) conclusions of the biological test analyses and interpretation; and (4) accuracy of the tables and figures. General comments are provided first, followed by specific technical issues and editorial notes.

GENERAL COMMENTS

The tech memo contained the principal elements that were stipulated in the SOW and Work Plan (Foster Wheeler 1998b), but without the level of information necessary to evaluate or interpret the results or form conclusions supported by the data. In general, the tech memo appears to be a data report, without data interpretation, explanation of results, or stated rationale for proposed Round 1B sampling decisions. Thus, we could not effectively evaluate the proposed Round 1B sampling design at this time. See also comments in cover letter.

In general, the accuracy of the tables and figures appeared satisfactory, recognizing that (1) the data tables presented unvalidated data, (2) raw data were not available to compare to the summary tables, and (3) comments and requests for changes to the figures (made in a September 30, 1998 meeting) have not yet been incorporated. The text that referred to the tables and figures contained many discrepancies and requires a thorough review and either clarification or correction by the authors.

SPECIFIC TECHNICAL COMMENTS

1. **Page 1-1, Section 1.2, Second Paragraph.** The tech memo's purpose and scope differs from the language used in the Work Plan and SOW in that the text referring to discussion and interpretation of results has been omitted. To better reflect the language and expectations in the Work Plan and SOW, additional text is recommended: insert "preliminary discussion and" before "summary of Round 1A sampling; insert "based on biological, sediment chemistry, and contaminant mobility tests" after "analysis results"; and insert "and provide a basis for additional collection needs" after "identify data gaps."

2. **Page 2-1, Section 2.1, Third Paragraph**. Please note the elevation of the shoreline/top of bank that is outlined on all figures.

3. **Page 2-1, Section 2.1, Third Paragraph** For clarity and to set the stage for proposed Round 1B sampling, the addition of a few sentences on the rationale behind the initial sampling location selection and analytical choices would be helpful (e.g., state why sixteen stations were analyzed for TBT pore water and why those locations were selected; state why MW021 and MW054 were selected for TAL testing).

4. **Page 2-1, Section 2.1, Fifth Paragraph.** At a September 24, 1998, meeting, WESTON requested that bank sample elevation ranges be added to the sampling forms or a table. Please include this information in the revised tech memo.

5. **P. 2-2, Section 2.2.1, First Paragraph.** Please include the detection limits in Table 2.

6. **Page 2.2, Section 2.2.1.1, First Paragraph**. Please discuss the rationale for focusing on exceedance ratios of 3.0 and 5.0 for mercury. If applicable, these ratios should also be discussed for the other chemicals exceeding SQOS. Please discuss the precedent (e.g., other waterway remedial actions) and the scientific basis (e.g., do other sites show natural recovery for chemical concentrations less than 3.0 times the SQO—for all chemicals? Are sediments exceeding an ER of 5.0 more likely to require dredging, rather than in-place capping?).

7. **Page 2-3, First Paragraph.** Please add definitions for all data qualifiers in Tables 2 and 3, and include those qualifiers in Figs. 3, 4, and 5.

8. **Page 2-4, Second Paragraph.** It would be appropriate to discuss potential sources of N-nitrosodiphenylamine in this tech memo. Are decomposed rubber tires (from tug/pier bumpers and cars/trucks via street runoff) a potential source?

9. **Section 2.2.2, First Paragraph.** Please confirm that the results presented in Fig. 4 are for 20 stations, not 16, and that 16 of the stations were sampled in 1998. Please explain why the MW030 subsurface interval between 5.5 and 7 ft is not reported on Fig. 4. Briefly discuss the data comparability between 1995/1996 samples and Round 1A samples, if this has not been done in previous documents.

10. **Page 2-5, Section 2.2.2.2, First Paragraph.** Based on Fig. 4, in the mouth of Middle Waterway LPAHs were also found at MW024 and MW031 (in the upper intervals), indicating more extensive distribution than just MW027 and MW030. Please discuss how the existing data or proposed sampling will address verification of the horizontal extent of these LPAHs.

11. **Page 2-8, Section 2.2.3.2. First Paragraph**. From this point, roughly 10 percent of the reported data were checked for accuracy against the tables. Given the number of errors or discrepancies to this point, (and listed under "Editorial Comments") please verify 100

percent of the remaining data reported in the text and correct any discrepancies.

12. **Page 2-15, Section 2.5.1.2, First Paragraph**. Please provide a discussion of the relevance of each benthic community analysis failure. As requested during the 24 September 1998 meeting, please provide a figure displaying biological test results similar to the figures depicting chemical results.

13. **Page 2-16, Section 2.5.2, First Paragraph**. Given the apparent failure of both MW208 and MW209 to meet performance standards, please explain why MW210 was not evaluated.

    Also, please provide the rationale for benthic community analysis sampling locations, which were selected after the work plan,.

14. **Section 2.5.3, Third Paragraph**. Regarding Table 13, Tables 4A and 4B from the SOW or Tables 24 and 25 from the Work Plan provide more appropriate descriptions of the biological effects interpretive criteria, rather than the Washington State Sediment Management Standards criteria, which (although similar) do not directly apply to this site.

15. **Page 2-17, Sixth Paragraph**. [Last sentence of paragraph continued on p. 2-18] This sentence should be reworded to indicate that, "...of the ten stations analyzed for benthic effects, station MW039 requires active remediation."

16. **Page 2-18, First Paragraph**. Rationale should be provided for using one composite sample to represent the potential dredge prism (as discussed briefly in the sediment geology section). Is the adequacy of this information affected by the results of sampling in the waterway head?

17. **Page 4-1, Section 4.2**. Figure 14 is difficult to read and should be revised/clarified so that proposed stations are distinguishable from previously sampled stations.

18. **Section 4.2.1, First Paragraph**. The assumption that the City of Tacoma will address intertidal and subtidal areas of the Middle Waterway has not been confirmed or substantiated with any supporting information in this report. In the Work Plan, the City's commitment to remediation is described as applying to the "higher intertidal," not below the banks. This paragraph should reflect the City's most recent discussions with MWAC and EPA to define the project area and confirm that MWAC will coordinate with the City to ensure that potential contaminant sources will be addressed.

19. **Section 4.2.2, First Paragraph**. The rationale and justification for defining "elevated" chemical levels were neither defined nor discussed. It appears that PAHs (and mercury) have become the analytical surrogate COCs for Table 8. Omitting SQO's from the list of

analytes requires extensive justification, as discussed in the letter. Please provide documentation of the rationale, based on the outcome of discussions following these comments.

20. **Section 4.2.2, Second Paragraph** Please explain why mercury was not included for the Round 1B five proposed surface samples, yet mercury exceedances at MW-1 and MW051 are in the area (MW050 and MW051) that is proposed for additional sampling. Given exceedances for PCBs and pesticides at MW008-SP, a benthic community test failure at MW049, and the proximity of MW105 to these two stations, please discuss why PCBs and pesticides were not included in the proposed analyses for MW105. Please explain the rationale for locating the five proposed surface sediment stations in a circle around MW107. What is the rationale for locating MW102 between MW051 and the bank? Please explain the rationale for collecting shallow subsurface cores to a maximum depth of 3 feet, when previous samples to 2 feet had SQO exceedances. It appears that the subsurface cores are focused on the vertical extent of PAH contamination west of MW050, but not to the north, south, or east. Please explain the rationale for this station positioning.

21. **P. 4-2, Section 4.2.3, First Paragraph**. Please define the levels of SQO exceedances that trigger the need for further delineation and state the rationale (e.g., "...sediments with SQO exceedances greater than a factor of 2 would not be expected to recover naturally to acceptable chemical concentrations in a ten-year period, based on site sedimentation estimates and studies in similar estuarine areas such as ___. Therefore, SQO exceedances greater than __ will require further definition before remedial activities are determined.").

22. **P. 4-2, Section 4.2.3, Second Paragraph.** *Please clarify why mercury (and other)* chemical exceedances greater than three times the SQO along bank sections 10a and 10b were not considered further. Please define the rationale used to justify no further chemical analyses for copper, lead, zinc, and arsenic (where chemical results exceeded a factor of two times the SQO). Please explain how the proposed samples MW112 and MW113 will further define the horizontal extent of COCs (especially mercury) between the abandoned barges and MW042, MW043, MW045, MW048, and MW049. Please discuss how the 2-foot-depth of proposed shallow subsurface samples will further delineate the vertical extent of mercury contamination (found to a depth of 3.5 ft at MW040). Please explain why pesticides and PCBs, present in bank samples at MW008-SP (and adjacent to MW049, where a benthic analysis failed), were not included in the Round 1B analytes for bank segments. Please state the rationale for determining which selected samples will be analyzed or archived.

    Please state the rationale for the cluster of surface sediment sampling stations around MW032 and MW035. These samples seem to offer little additional horizontal definition to the mercury contamination found around/throughout the MW029 through MW032 area.

Please clarify figure so that proposed station MW32 (near MW029, Fig. 14) is clearly recognizable as MW132. Please explain why a gravity core sample is proposed between MW028 and MW031, but not south beyond MW035 (where diethylphthalate was found to a depth of 8 feet with an exceedance factor 5.5 times the SQO). Please justify the maximum core depth of 4 feet, although COCs were found to a depth of 8 feet.

23. **P. 4-3, Section 4.2.5, Third Paragraph**. Please explain why copper is not proposed for analysis, although elevated levels (2.79 times the SQO) were found along the bank near Segment 13. Please explain rationale for placement of the proposed stations around MW025, including bank samples. Please explain how the horizontal extent of COCs will be determined between MW139, MW136, and MW020. Please explain the rationale for defining the horizontal extent of mercury found along the bank of segment B-12 between MW137 and MW028. Please explain if the vertical extent of COCs in this area will be defined by the vertical extent (to a depth of 5 feet) of mercury at MW025.

24. **Section 4.2.6, Third Paragraph**. Please state the rationale for co-locating six additional bioassay stations at those locations. Please state the rationale for classifying an EF less than 2.5 as "slight" and thus performing acute bioassays at those locations, but not at others. Please explain the method for defining the horizontal and vertical extent of PCBs in MW03a.

25. **Page 5-1**. This section does not contain the "elements of a natural recovery demonstration" as specified in the Work Plan. In lieu of a natural recovery framework, a detailed discussion of why natural recovery is unsuitable should be developed. Perhaps a technical meeting specific to the utility and possibility of natural recovery should be proposed by MWAC at this time.

In addition to the tech memo data report, WESTON briefly reviewed *Preliminary Estimates of Dredge Volume and Contaminant Mobility Test Results in Support of Combined Disposal* (Foster Wheeler and Hartman Consulting Corp. 1998). In general, the report is a data presentation with no evaluation or interpretation of results. The final report should include significantly more detail and discussion. Specific comments follow.

26. **Section 2.2, First Paragraph.** Clarify whether 20 or 34 subsamples were collected within the tideflat and subtidal area.

27. **Section 3.2**. Please state that the surface and bank data exceeding SQOS were not included in this evaluation. Please clarify that subsurface SQO exceedances in the middle and head of the waterway (from centerline survey station 15 to 21, and from 22 to 42) were not included in the evaluation or dredge volume estimates.

28. **Section 3.1**. Please provide an estimate of the volume expansion expected with dredging. This volume will be critical in determining dredge disposal options.

29. **Section 4.0.** Please provide a complete discussion of how the composite sample was created. Describe how it was determined that the composite was representative of the potential dredge prism and specify sections of cores that were combined.

30. **Section 4.4, First paragraph.** The purpose of defining the characteristics of the mixture of all the sediment is not clear. The entire mass of placed sediment will not be mixed. As the sediment is dredged and placed it will retain its characteristics.

31. **Section 4.4, Second Paragraph**. It is assumed that the second sentence refers to clamshell dredging. Please clarify the type of dredging. In the last sentence, please indicate that an option to water treatment may be incorporation of a sufficiently large retention pond to allow particulate to settle.

32. **Table 1**. Include units with the concentration heading. Clarify if the absence of values in the table indicates that there were no exceedances or if no analysis was performed.

    The exceedance factors do not match those shown on Figure 4 in the report. For instance, at MW-24, Table 1 shows an exceedance of 1.08 for Fluoranthene and Figure 4 shows 2.64. Several other discrepancies have also been noted. The samples used for the composite were mostly from the north end of the waterway. Samples from the south end, such as TF-22 have significantly higher PAHs. Its likely that the resultant PAH concentrations may be low.

33. **Table 2**. Discuss how the results for the Thea Foss Waterway are pertinent to the disposal evaluation in this report.

    The concentrations of PAHs in the mobility tests are much lower than the average for the waterway. This should be factored into the conclusions when the DRET and MET data are reviewed.

34. **Table 4.** Provide plots of analyte concentration versus pore volumes eluted so trends can be more readily observed.

35. **Attachment 1.** The particle size distribution for the material used to perform these tests should be provided. State which samples or sample locations were used to perform the settling tests. Settling tests should be run on several different samples representing the range of expected grain size. These tests would allow an estimation of what portion (volume) of the sediment is likely to be problematic for meeting water quality standards.

36. **Graph 2.** Provide a footnote indicating what parameter is being presented and what the initial concentration was.

EDITORIAL COMMENTS

1. **Page.2-1, Section 2.1, Paragraph 4**. What does "(MW053)" refer to? Should the reference to Section 4 be changed to Section 2.6?

2. **Page 2.2, Section 2.2.1.1, First Paragraph**. Remove "only" from the phrase "only two samples had exceedance factors greater than 5.0." Based on Figure 3, please confirm that 14 (not 15) of the 21 samples had exceedance factors of less than 3.0.

3. **Page 2-2, Section 2.2.1.2, First paragraph.** Fluorene is misspelled in Fig. 3 at MW028.

4. **Page 2-3, First Paragraph.** Based on Figure 3, please confirm that 5 (not 6) benzo(a)anthracene samples, 4 (not 5) benzo(a)anthracene samples, 7 (not 8) fluoranthene samples, 4 (not 5) indeno(1,2,3-cd)pyrene samples, and 1 (not 2) dibenzo(a,h)anthracene samples (no EF is shown for TF-23 in Fig. 3 or Table 2) exceeded the SQO. Benzo(g,h,i)perylene is misspelled in Fig. 3 at TF-23. [Please add definitions for all data qualifiers in Tables 2 and 3, and include those qualifiers in Figs. 3, 4, and 5.]

5. **Page 2-3, Third Paragraph.** Based on Fig. 3, please confirm that two (not one) total PCBs samples (see TF-23) exceeded the SQO.

6. **Page 2-4, Second Paragraph.** Phenol was reported in the previous section on phenols.

7. **Section 2.2.2, First Paragraph.** Please confirm that the results presented in Fig. 4 are for 20 stations, not 16, and that 16 of the stations were sampled in 1998.

8. **Page 2-5, Section 2.2.2.2, First Paragraph.** Please confirm that the greatest concentrations of the LPAHs anthracene (exceedance factor of 6.56), naphthalene (exceedance factor of 5.24), and 2-methylnaphthalene (5.24) were found at MW050, not TF-22. Please confirm that the greatest exceedance factor for fluorene was 48.00 (not 10.74) in the second interval at TF-22.

9. **Page 2-6, First Paragraph**. Based on Figure 4, please confirm that 8 (not 7) benzo(a)anthracene samples exceeded the SQO by a maximum factor of 20.00 at TF-22 in the second interval. Please confirm that dibenzo(a,h)anthracene exceeded the SQO by a factor of 20.00, not 22.00. Please confirm that 10 (not 8) samples exceeded the SQO for fluoranthene. Please confirm that 9 (not 8) samples exceeded the DQOS for pyrene and total HPAHs.

10. **Page 2-7, First Paragraph**. Based on Fig. 4, please confirm that 2,4-dimethylphenol exceeded the SQO at four (not three) stations, including MW050.

11. **Section 2.2.3, First Paragraph**. Please clarify the first sentence so that the 25 samples reported on Fig. 5 can be reconciled with the 21 locations mentioned in the text.

REFERENCES

United States Environmental Protection Agency (USEPA). 1996. Statement of work for remedial design for the Commencement Bay Nearshore/Tideflats Superfund Site—Middle Waterway problem area, Pierce County, Washington. Appendix I. USEPA Region 10, Seattle, Washington. 47p.

Foster Wheeler. 1998a. Round 1B technical memorandum for Middle Waterway Problem Area of the Commencement Bay Nearshore/Tideflats Superfund Site. Prepared for the Middle Waterway Action Committee. September 28, 1998.

Foster Wheeler. 1998b. Revised final pre-remedial design and remedial design work plan including summary of existing data for Middle Waterway Problem Area of the Commencement Bay Nearshore/Tideflats Superfund Site. Prepared for the Middle Waterway Action Committee. February 23, 1998.

ADDITIONAL EPA COMMENTS:

1. Page ii - Update appendix list

2. Page iii - Update list of figures

3. Page 2-13 and 2-14 - Section 2.4 Sediment Geology - The "practical implications" discussion at the end of this section is a little inconclusive. This section should indicate whether a visual or other distinction could be made between pre-contamination sediments and more recent layers. Does native sediment always occur below a certain elevation? Would sediments from a deeper layer be expected to be clean, unless a subsurface pathway exists? These questions could help limit coring depths or assess how contamination came to be in the deeper sediment layers, and whether there are ongoing subsurface inputs which could lead to recontamination. Does the discussion of sediment geology have any bearing on biological effects? Does contamination tend to be found in association with one or another type of geological material? Note when stating the conclusions that without further information, the conclusions do not apply to sediments in the waterway tideflats.

4. Page 2-15 Section 2.51.2 Benthic Community - It is unclear why, if all benthic reference

stations are said to fail the criteria in Tables 24 and 25 of the Work Plan, only the stations that would fail are designated as inconclusive (TBD). It does not appear that MWAC wishes to reject the entire data set. EPA believes it is acceptable to use the Hylebos reference stations as they are presented, based on habitat characteristics and community composition. The "fail" designation should be retained for Stations MW39 and MW49, but Station MW54 should be considered a "pass". This is based on an evaluation of the benthic data provided by MWAC separately from the Technical Memorandum. The evaluation is provided as Enclosure A to this letter.

5. Page 2-18 - Section 2.6 Contaminant Mobility Results - This section should provide a summary statement or statements regarding what the contaminant mobility tests showed. Note that EPA has not seen adequate justification for viewing the tested sediments from the mouth as representative of potential dredge volumes in the head of the waterway. For example, if PAH sources areas at the head are to be dredged, will the PAH concentrations be comparable to those at the mouth? Are the grain sizes similar? This may be a data gap which requires further testing. Perhaps archiving samples from cores in Round 1B would allow later testing without a separate field effort.

6. Page 3-1 - Estimate of Sediment Volume that May Require Active Remediation - The specific limitations of the estimate referenced should be discussed. For instance, the fact that the dredge volumes do not include sediments at the head should be mentioned. Are the proposed tests intended to support NOT dredging sediments at the head? As a related issue, we are uncertain if MWAC intends to use further testing in the preliminary dredge area at the mouth of the waterway to reduce the dredging volumes--but we note that certain samples (for example, the core at Station 133, Station 132) seem designed to do so. Please provide a rationale.

7. Page 4-1 - Section 4.1 - Geotechnical Data - Please add "Gaps" to heading. Also, state why additional geotechnical data are not needed at this time. Is there another time that such information may be needed? How would the information gathering be worked into the schedule and process? What are the implications of the information provided in Appendix A.

8. Page 4-1 - Section 4.2 - Pursuant to our recent discussions with the City of Tacoma project lead for the restoration project, please modify. The city has not clearly indicated that they will be addressing the area as a potential source. Continued discussions will be necessary as the project is further defined. In addition, the project boundaries have been clarified, leaving a larger area within the purview of Middle Waterway remedial design.

9. Page 4-1 - Section 4.2.2 - Section 4.2.6 - Please note that subsurface conditions may have to be examined regardless of whether the surface sediments are clean or whether, despite contamination, biological effects are not shown. The reason for such an examination is that

the subsurface contamination may pose a threat of contaminant migration upward or may be exposed through erosion. This potential should be discussed. Note also the following:

- benthic evaluations are still considered appropriate for the chronic measure of biological effects;
- biological testing must be accompanied by conventional sediment analyses at a minimum, and EPA recommends chemical testing to help understand the reason for test failures (Please describe the likelihood of collecting biological test sediments within sufficiently close range of previous chemical tests to represent previously tested conditions);
- while mercury and PAHs may predominate in an area, contaminants that occur sporadically in banks, surface, and subsurface samples cannot be overlooked without further discussion of potential sources and pathways, and in most cases further analysis;
- in areas where sampling is still widely spaced, we recommend refining sediment volumes through additional sampling to avoid a large volume of sediment being represented by limited data; the reason for the depth of the shallow cores proposed should be better supported or deeper cores planned for;
- do the bank samples along the Marine Industries and General Construction shoreline need to be as closely spaced? would it be more productive from a design standpoint to focus more on potential subsurface and lateral contamination in the waterway? could other information such as a few upland soil samples, a field survey or review of operational history help yield an upland source?
- do the samples proposed around station 25 adequately represent potential depth and lateral distribution of contamination? Perhaps archiving samples from greater depths and distances from 25 would be advisable.
- is there no further sampling proposed of the boat ramp (near Station 11a-SP) because the area is going to be added to a dredge prism? Please discuss.
- are chemical data needed near 4b-SP to determine what actions may be needed?
- why is no additional biological testing proposed at sample locations on the west side of the centerline?
- by focusing on shallow samples near "hot" stations, are you assuming that the material was deposited through sediment transport? If so, you might overlook contamination present in the subsurface due to groundwater transport or direct dumping.

- why are the cores near stations MW50 and MW51 shallow?
- what might have caused the benthic impacts near Coast Craft? Have TICs been reviewed?
- what pathways might have led to subsurface contamination near the head?

We encourage you to consider these points and discuss them with EPA at the proposed meetings.

10. Page 5-1 - Section 5 - Natural Recovery Approach - This section was lacking in substance. Now is the time to determine whether MWAC will accept the chemical evidence or challenge it through biological testing, or seek to assess natural recovery as a possibility. How will areas for which natural recovery may be appropriate be determined if not through sampling or other evaluation at this stage? What information is needed to make that determination? At a minimum the document should state whether natural recovery is an appropriate proposal for broad categories of sediments or general areas which MWAC intends to dredge. It may be useful to refer to the SRAL information developed in the ROD, which states preliminarily that stations failing the SQO by a factor of less than 1.2 may be capable of natural recovery. Are there areas that fit that description? Is there a way to discuss what the mechanisms of natural recovery would be in this setting?

11. Page 7-1 - Section 7 - References - This list seems incomplete. Other studies whose data are presented here should be listed, as well as the ROD and RD SOW. We discussed the potential availability for more current data from the Simpson monitoring of the shoreline restoration site. Please include relevant information and reference the report if available.

12. Figures - We discussed the presentation of a more summary list of chemicals (such as LPAHS, HPAHs and mercury), and a draft was presented briefly at a meeting in early October. Including this in a document revision would be of use. In such a figure, including both bank and surface samples would also be helpful. Figure 14 continues to be difficult to read. Reviewers should be able to distinguish past from proposed samples. Can the figures be marked to show areas potentially linked by a given pathway to a potential source area? This may be useful in supporting the proposed further sampling and the selection of analytes.

REVIEW OF BENTHIC REFERENCE STATIONS FOR THE MIDDLE WATERWAY REMEDIAL DESIGN PROJECT

WESTON reviewed the benthic data, as provided by Foster-Wheeler, for the reference stations used in the evaluation of remedial design data for the waterway cleanup being conducted by the Middle Waterway Action Committee (MWAC). Foster-Wheeler had called into question the interpretation of the results at stations MW39, MW49, and MW54, where the results indicated benthic impacts based on the reduced abundance of molluscs, crustaceans and/or polychaetes. Foster-Wheeler's particular concern was that reference stations were not appropriate because of the dominance of pollution tolerant taxa. Also, at two of the reference stations (MW205 and MW207), the total organic carbon (TOC) was elevated relative to all but one of the site stations. These two parameters were identified in the AOC SOW as key characteristics that would be used to determine matching reference stations for Middle Waterway sampling locations. A third parameter, grain size, was the primary characteristic that was used to match reference samples with Middle Waterway samples. For this study, reference grain size matches were available for all comparisons with Middle Waterway samples.

WESTON evaluated the reference characteristics based on habitat characteristics and the abundance and richness of major taxa and total abundance and total richness, along with dominance and species composition. The benthic community from the inner Hylebos Waterway reference area appears to be healthy and diverse for this type of habitat. An average of 30 to 40 taxa were present at each sampling location. Abundances were more variable and ranged from about 170 to 590 individuals per grab. Two of the three reference stations (MW205 and MW207) did exhibit high dominance, primarily because of the presence of the corophiid amphipod *Monocorophium* spp. This organism builds a muddy tube in fine-grained, silty sediments, and is often found in large aggregates on the bottom. This behavior fosters the settlement of many epifaunal and other tube-building, suspension-feeding organisms, because the tube mats create a unique three-dimensional substrate on a flat mud bottom. Organisms that burrow tend to have difficulty colonizing an area where corophiid species are abundant, thus molluscs may have reduced abundances in these communities. This was evident in the reference area, where molluscs were depauperate.

Other species were also fairly abundant at the reference stations. Among the top 5 numerically dominant taxa was the tubicolous polychaete, *Manyunkia aestuarina*, which is a detrital feeder. *Manyunkia* abundance appears to vary with *Monocorophium*, probably because of the increase in food from entrapment of detritus by the amphipod tubes. Capitellid polychaetes were also among the most abundant taxa. *Capitella* spp. are generally considered pollution-tolerant taxa. Their tolerance comes from an opportunistic life strategy that ~~that~~ allows them to be a successful colonizer following physical or chemical disturbances in the environment. Their life cycles tend to be very short, which serves to minimize their exposure to toxicants. They also are very small and live only in the top centimeter or so of the sediment, which allows them to exploit microhabitats, when available. In the case of the reference area, these species appear to be acting primarily as opportunistic, rather than pollution-tolerant taxa in response to the presence of *Monocorophium* tubes. *Capitella* spp. increases in abundance were *Monocorophium* is abundant and drops in abundance when *Monocorophium* does.

Several spionid polychaetes, which are also detrital or suspension feeders, and a crustacean (*Leucon sp.*) were also among the top 5 most abundant organisms. These organisms are present at all site and reference stations and do not seem to show any particular relationship with other dominant taxa.

The *Monocorophium* tubes may alter the substrate characteristics by trapping organic flocculents and detritus and other biogenic material in the nooks and crevices formed by the mats. The tubes may also provide a substrate for benthic and small macroalgae. This type of substrate alteration would likely be expressed as an increase in the total sediment organic carbon. This is illustrated by the high total organic carbon present where *Monocorophium* were very abundant (MW 205, MW207 and MW54). A grain size alteration would not necessarily be expected because the tubes are built from native sediment and the detrital fraction of the sediment would not be captured as part of the grain size analysis.

To summarize, the species composition of the dominant taxa at the reference stations reflects the strong influence of the substrate alternation caused by *Monocorophium* amphipods rather than the presence of pollution. In addition, the taxa that were present are fairly common in dynamic, shallow habitats, where physical disturbances may be more prevalent. Total taxa richness and total abundance also seemed reasonable for the habitat represented by the reference stations, with the possible exception of abundance at Station MW206. This station was reduced in abundance relative to the other reference stations (less than half the next most abundant reference station), but had similar diversity as measured by taxa richness. Although benthic abundance measures can be highly variable (typically up to a factor of 2) within similar types of habitats, the abundance of MW206 is more slightly more depauperate than would be expected. It is likely that this station may have been disturbed in recent time and is not yet fully recovered.

The elevated TOC at the reference stations appears to be due to the influence of the *Monocorophium* tubes. The underlying sediments still provide a close grain size match for the purposes of determining which stations should be used for comparisons to site stations.

WESTON recommends that comparisons to reference stand as they are presented in MWAC's recent Round 1 data evaluation report. The reference stations are acceptable based on both habitat characteristics and community composition. Grain size matches between the individual reference stations and individual site stations are very close. Middle Waterway benthic communities are similar in composition to the inner Hylebos Waterway and share many of the same dominant taxa. *Manyunkia aestuarina* and *Capitella* spp. are the top two dominant taxa in Middle Waterway samples, with the exception of Station MW54 where *Capitella* is much less abundant and Station MW43 where *Monocorophium* spp. is relative more abundant than *Manyunkia*.

WESTON further recommends that the benthic failure based on reduced molluscan abundance at MW54 be reinterpreted. This station had a high abundance of *Monocorophium* and molluscs would be expected to be rare. The reference station selected for comparison to this station had more than 5 times fewer *Monocorophium* present (167 versus 31). It appears to be appropriate to set aside the benthic failure at this one station.

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OCT 20 1998
Environmental Cleanup Off

October 16, 1998

To: Elly Hale
EPA

From: John Carleton

SUBJECT: MIDDLE WATERWAY PROBLEM AREA - ROUND 1B TECHNICAL MEMORANDUM

Randy Carman and I have reviewed and discussed the Round 1B Technical Memorandum. We have just a few comments and concerns to offer.

In general, the work appears to have been well done, providing a good basis for moving on to the next round. However, because this is intended to be the final round, we recommend that sufficient samples be taken to assure that contamination can be delineated adequately, both horizontally and vertically. In some instances, it may be appropriate to archive samples for phased analysis as needed.

One area where more detail would be useful is the PCB hotspot at station MW031. A particular concern is that subsurface samples on the northern half of the head of the waterway did not look at more than two feet of sediment, while the highest PAH contamination on the southern half (station TF-22) appeared to occur below two feet. Although it is true that WDFW looks on Middle Waterway as a potential restoration/resource area, and would like to minimize disturbance of the habitat, we are not yet ready to recommend that the sediments be left in place at the head of the waterway, especially since the source of PAH contamination has not yet been determined. To allow for flexibility in the final remedy, we recommend that the extent of PAH contamination be delineated more fully.

We understand that the Middle Waterway Action Committee (MWAC) disputes the results of benthic analysis because of an issue with the particular reference sites. We believe that benthic tests are appropriate as a tool for remediation planning. In this case, the reference sites were at a relatively uncontaminated area within a waterway that has not yet been remediated. Are benthic populations there as healthy as they will be post-remediation? If not, the benthic test failures disputed by the MWAC would be even more significant.

Finally, we are concerned that remediation action levels for PAHs may not be protective of fish. There has been work done in Puget Sound indicating that threshold levels of 0.5 to 2 ppm total PAHs in sediments can cause early hepatic lesions and DNA damage in benthic fish.[1] These threshold levels are considerably below the SQOs. We ask if there has been any reconsideration of levels set in the Commencement Bay ROD, given the scientific work on fish impacts that has taken place in the intervening years.

1. Johnson, Lyndal L., Meyers, S., Goyette, D., and Addison, R. F. 1994. Toxic Chemicals and Fish Health in Puget Sound and the Strait of Georgia. Proceedings: Symposium on the Marine Environment - 1994 (304-329).

Attachment 2

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November 25, 1998

Via Facsimile & By Regular Mail

Ellen Hale, Project Manager
U.S. Environmental Protection Agency
Region 10, Mailstop ECL-115
1200 Sixth Avenue
Seattle, Washington 98101

Re: Middle Waterway – Commencement Bay Nearshore/Tideflats Superfund Site
Request for Extension for Submitting Revised Round 1B Technical Memorandum

Dear Ms. Hale:

EPA's final version of its comments on the Round 1B Technical Memorandum ("Memo") were received by representatives of the Middle Waterway Action Committee ("MWAC") on Friday, November 20, 1998. The comments allow for the submittal of a revised memo within 20 days, or on or before December 10, 1998. Unfortunately, due to the three-day work week preceding Thanksgiving and the fact that EPA elected to mail the comments to ensure receipt by MWAC on a Friday, MWAC has 12 days in which to prepare a response to EPA's 72 comments (61 substantive, 11 editorial, excluding the general comments contained in the cover letter).[1]

[1] It is interesting to note that, despite the characterization of the submittal in the Statement of Work ("SOW") as a "technical memorandum" (which is in keeping with the objectives in the Administrative Order on Consent ("AOC") and SOW to limit data collection and postpone detailed data evaluations until submittal of the Pre-Design Data Evaluation Report, Evaluation of Remedial Options, and Recommended Remediation Plan), EPA's comments on the Memo exceed those submitted on the draft Sampling and Analysis Plan (6 general, 50 substantive, 11 editorial). MWAC had also agreed to a reduced period for submitted revisions to that deliverable (i.e., 30 days instead of 45).

This letter requests an extension until January 18, 1999 to respond to EPA's comments. Had MWAC believed during negotiations of the Administrative Order on Consent ("AOC") and SOW that it was EPA's intent to require a detailed data evaluation in lieu of a Memo that identifies and provides a basis for Round 1B sampling locations, it would never have agreed to a 15-day turnaround. The 15-day time period was based on the submittal being a memo and not a data evaluation report.

It appears that EPA is attempting to convert the Memo into a Round 1 Data Evaluation Report. This is evidenced by EPA and Weston's references to the Memo as a "tech memo data report" (see Comments, page 5) and as a "Round 1 data evaluation report" (see Review of Benthic Reference Stations). EPA is requiring MWAC to address items that are more appropriately addressed, according to SOW, in the deliverable entitled "Pre-Design Data Evaluation Report, Evaluation of Remedial Options, and Recommended Remediation Plan." For example, EPA is requiring MWAC to revise the Memo to incorporate:

- An evaluation – station by station – of the results of Round 1A sampling, including all historical sampling and analyses, as evidenced by the following excerpts from EPA's comments: "the document presents limited data evaluation;" "unless MWAC can demonstration on a station by station basis to EPA's satisfaction that adequate information has already been obtained;" "further discussion should be provided...regarding whether the existing and proposed data will support an assessment of the potential for recontamination;" "a systematic discussion is needed;" "without the level of information necessary to evaluate or interpret the results or form conclusions supported by the data;" "the tech memo appears to be...without data interpretation, explanation of results, or stated rationale;" "discuss data comparability between 1995/1996 samples and Round 1A samples;" "provide a discussion of the relevance of each benthic community analysis failure;" "provide a complete discussion;" "further discussion of potential sources and pathways;" "what pathways might have led to subsurface contamination near the head?"; "what might have caused the benthic impacts near Coast Craft?".
- Substantial revisions to a document (MWAC's *Preliminary Estimates of Dredge Volume and Contaminant Mobility Test Results in Support of Combined Disposal*, Foster Wheeler 1998) that was submitted merely to provide a conservative estimate of volumes of sediment which may require active remediation for purposes of combined disposal. It is not an EPA deliverable and, therefore, will be removed as an attachment to the Memo. The SOW merely requires that the Memo provide a preliminary discussion of the results of Round 1A sampling, including bioassay results, sediment chemistry, and contaminant mobility tests, and provide an estimate of the volumes of sediment which may require remediation. EPA's comments direct MWAC to "include significantly more detail and discussion."
- An evaluation of the potential for sediment recontamination, as evidenced by EPA's statements that "a systematic discussion is needed (property by property, or area by area, for example) indicating how permitted discharges, unpermitted smaller outfalls, banks, and other potential sources have been (or will be in Round 1B) adequately

characterized for purposes of assessing potential recontamination. Recontamination from subsurface areas should also be considered."

The SOW for the Middle Waterway was specifically negotiated to delete a Round 1 Data Evaluation Report. Originally, the draft SOW contained a statement that "This [Round 1 Data Evaluation] report will provide an evaluation of each of the bulleted items under Section II.B.1.c." Those bullets, which the negotiated SOW requires MWAC to address in the Pre-Design Data Evaluation Report, Evaluation of Remedial Options, and Recommended Remediation Plan (to be submitted 120 days after EPA's receipt of the Round 1B Data Report), include:

- spatial resolution of chemical contaminant distribution
- physical characterization of the waterway
- assessment of sediment toxicity with respect to potential biological effects
- assessment of the potential for natural recovery of sediments
- assessment of habitat distribution and resource use
- assessment of sediment contaminant mobility
- assessment of the potential for sediment recontamination
- characterization of capping materials and confined disposal site(s)
- assessment of water quality impacts of dredging
- evaluation of habitat mitigation requirements, if necessary
- evaluation of the behavior of dredged material to support detailed evaluation of confinement options
- evaluation of current and planned property uses

EPA's comments require the Memo to include discussion of all but four (4) of the above-listed bullets. It remains our position that the Memo, as drafted, meets all of the objectives of the SOW and the EPA-approved Work Plan. While MWAC will respond to EPA's comments, we believe that EPA may be misconstruing the intent of the Memo. It is not intended to serve as a substitute for a Round 1 Data Evaluation Report. Such evaluation is not required until submittal of the Pre-Design Data Evaluation Report. A discussion of the results of historical sampling, which formed the basis and rationale for the sampling conducted during Round 1A, was included in the EPA-approved Work Plan. A preliminary discussion of the results of the Round 1A sampling was included in the Memo. If EPA insists on further detailed discussions and evaluations of previous sampling rounds and of the items listed in Section II.B.1.c. of the SOW, then we respectfully disagree that (1) it is required by the SOW; (2) it can be done in the time allotted; or (3) it can be done in the absence of a mutually-agreed upon modification to the AOC and SOW.

It bears emphasis that Round 1B is not a sampling event that will take place in a vacuum. It follows hundreds of samples taken from banks, surface sediments, and subsurface sediments of a waterway that is significantly smaller in size than the Thea Foss/Wheeler-Osgood Waterways

and the Hylebos Waterway. The waterway is approximately 3500 feet long and varies in width from 300 to 500 feet. Half of the waterway is shallow, intertidal areas.

MWAC has accomplished more in a shorter period of time than any of the other waterways at this stage of the pre-remedial design process: (1) it completed chemical and biological testing during Round 1A, rather than rely on tiering; (2) it completed contaminant mobility testing; and (3) it developed a conservative estimate of sediments volumes that may require remediation for purposes of combined disposal. MWAC continues to believe in the objectives of the AOC and SOW, which include not spending more on pre-remedial design and remedial design ("PRD/RD") than will be spent on actual cleanup.

Notwithstanding the disagreements between the parties on some of the technical issues, it cannot be disputed that Middle Waterway has more data at this stage of the PRD/RD process than any other waterway. For example:

1. A total of **246** data points were obtained prior to Round 1A:
   - 71 samples of banks, seeps and outfalls
   - 98 samples of surface (0-1 foot) sediments
   - 77 analyses from 22 core locations of subsurface (>1 foot) sediments
2. During Round 1A, MWAC developed an additional **93** data points:
   - 21 bank samples
   - 33 samples of surface sediments
   - 39 analyses from 16 core locations of subsurface sediments
3. For Round 1B, MWAC is proposing:
   - 18 bank samples
   - 23 samples of surface sediments
   - 15 analyses from 5 core locations

Even without Round 1B, there are a total of **339 data points** for the Middle Waterway. A figure showing the location of these samples is attached (and will be included in the Revised Memo).

Through September 25, 1998, MWAC has incurred over **one million dollars** in pre-remedial design costs, which amount does not include EPA oversight costs, pre-Round 1A sampling (a large portion of which was paid for by an MWAC member), the substantial source control measures implemented by members of MWAC (including nearly $750,000 for a stormwater collection and treatment system under a MTCA Agreed Order), or EPA's past costs associated with the Middle Waterway. If included, approximately three million dollars will have been spent on this small waterway. If allowed to expand the scope of Round 1B sampling, EPA could force MWAC to incur an additional $800,000 in pre-design sampling and analytical costs alone (which amount would not include data evaluation, preparation of the Pre-Design Data Evaluation, Evaluation of Remedial Options, and Recommended Remediation Plan, or EPA oversight costs). By the time the cleanup plan is submitted, PRD/RD costs could very well approach **five million dollars or more**. For a waterway with a conservative estimate of 75,000

cubic yards of sediment which may require active remediation (at a potential cost of $18 to $24 per cubic yard), the PRD/RD costs could end up being several times higher than the costs of remedial action. This is not in keeping with EPA's mandate to not spend more money to study a problem than it would cost to fix it.

Given the costs that are at stake and the apparent desire by EPA to expand the Round 1B sampling effort to include, among other things, dioxin evaluations and benthic testing, it is clear that further discussions are needed to work through several of the more complex issues on which the parties continue to disagree. These include the level of uncertainty with respect to dioxin testing in Commencement Bay (including, among other things, whether such sampling should be required of one waterway but not of the others), acceptable concentrations of PCBs (in the form of a threatened citizen suit over EPA's revised cleanup level), and acceptable concentrations of PAHs (in the form of trustee concerns over current SQOs). We believe that the meetings that have taken place to date have been constructive and have begun to move the parties toward resolution. However, the most important of these issues, in MWAC's opinion, is a fundamental difference of opinion over the required scope of the Memo and of Round 1B sampling in light of the 339 sample results already available on this waterway. Absent the extension, the limited time frame for revising the Memo will reduce MWAC's ability to devote the time necessary to develop a technical approach that will meet both parties' interests and that will result in a timely, cost-effective cleanup of the smallest waterway in Commencement Bay.

To complicate matters, MWAC received EPA's oversight cost accounting (in the amount of $166,566.70) on November 17, 1998, a mere three days before receiving EPA's comments on the Memo. MWAC is now simultaneously facing a sixty-day time limit for reviewing EPA's documentation, which was submitted 7-1/2 months after the AOC's anniversary date, and disputing any costs. We also expect to receive comments from EPA on our Round 1A Data Report, which was submitted on October 27, 1998.

MWAC fully intended and expected that it would be able to initiate a one-time mobilization to complete Round 1B sampling by late October/early November. That is indicative of MWAC's understanding of the purpose and objectives of the Memo. MWAC's concerns over the costs associated with conducting two mobilizations for one sampling event have been expressed to EPA repeatedly throughout this process. Those same concerns resulted in MWAC's decision to conduct non-tiered chemical and biological testing during Round 1A. Moreover, both parties agree that it was preferable to avoid biological testing during late fall and winter. It is a general concern of the technical community, including EPA's consultants, that performing biological testing during the latter half of the fall season or during the winter season leads to problems, including the use and availability of viable test species. Experience has demonstrated that viable test species and reliable test results are best achieved during other seasons of the year.

We do not believe that conducting Round 1B testing in the Spring of 1999 will have any effect on any party's schedule, including EPA timelines, or on opportunities for combined disposal. The City of Tacoma was recently granted an extension (i.e., until December 17, 1998)

We do not believe that conducting Round 1B testing in the Spring of 1999 will have any effect on any party's schedule, including EPA timelines, or on opportunities for combined disposal. The City of Tacoma was recently granted an extension (i.e., until December 17, 1998) to respond to EPA's 267 comments on the Round 3 Data Evaluation Report for the Thea Foss/Wheeler-Osgood Waterways. That report will presumably undergo additional review by EPA and perhaps a subsequent revision by the City before final approval. As for the Hylebos Waterway, the Hylebos Cleanup Committee has not yet submitted its Draft Round 2 Data Report. Finally, neither the habitat mitigation that will be required by the resource agencies for confined disposal at the proposed St. Paul site nor EPA's 404(b)(1) analysis has been completed, subject to PRP review, or finalized in a cleanup plan.

By granting an extension until January 18, 1999, EPA will allow the parties to continue to discuss and negotiate a resolution to the technical disputes with consideration of holiday and business schedules, without the necessity of invoking more formal procedures. Given the number of issues involved and the deadlines which we are being asked to meet, please advise us if it would be constructive (and would save time for all concerned) for us to forward copies of this extension request to others in the Site Cleanup Unit 3 and, if so, to whom.

We appreciate your consideration of this request.

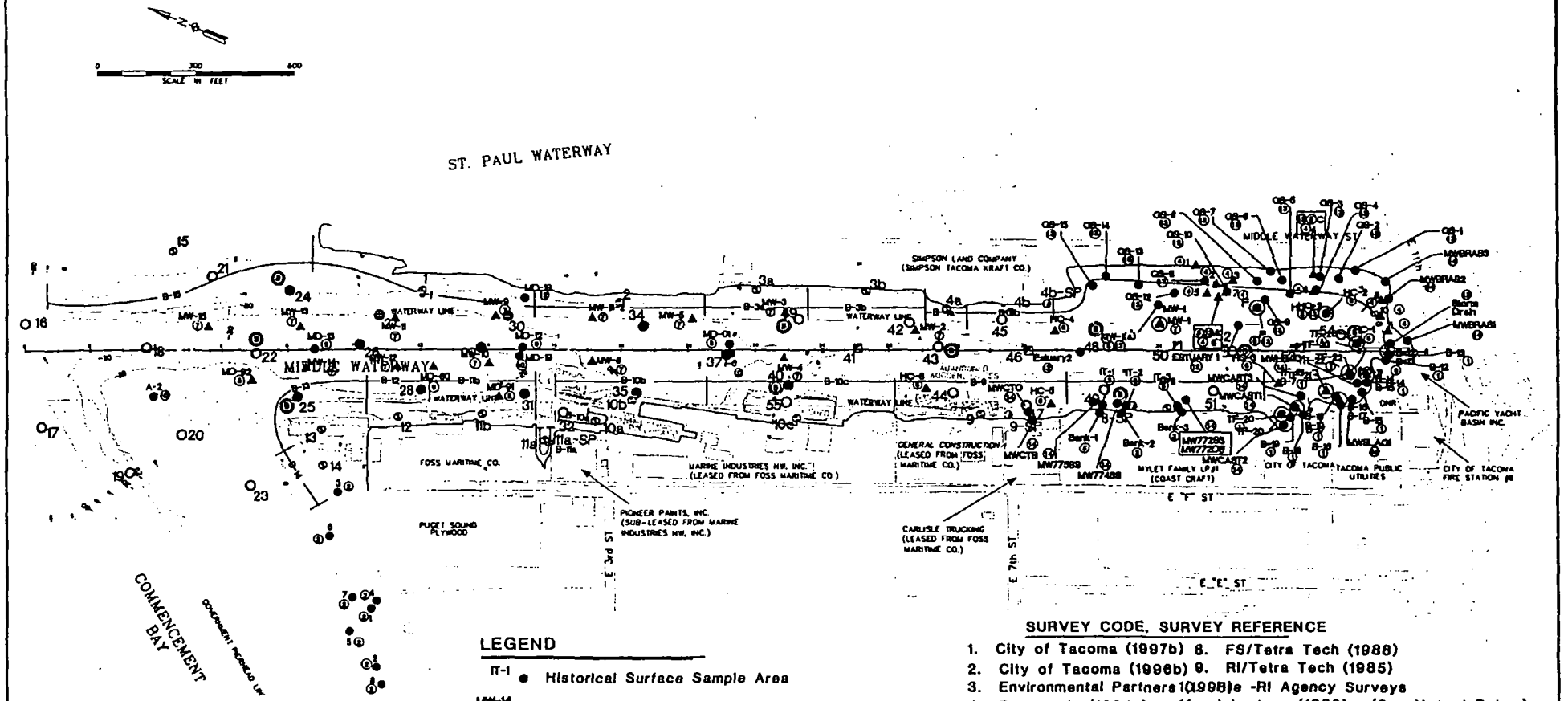
Very truly yours,

Kim Maree Johannessen

Kim Maree Johannessen, on behalf of the
Middle Waterway Action Committee

KMJ:fya
Enclosure
cc: Tod Gold, Assistant Regional Counsel (***via facsimile***)
David Templeton, Project Coordinator
Middle Waterway Action Committee

bcc: ***(all via facsimile & by regular mail)***
Doug Kotrba, Senator Gorton's office
Hans Hechtman, Congressman Smith's office
Andrew Monroe, Congressman Dicks' office



LEGEND

- Surface Sediment Sample Location
- Surface Sediment and Co-located Subsurface Sediment Core Location
- Shallow (0-2 feet) Subsurface Sediment Sample Location (1 composite sample)
- —B-12— Waterway Bank Sections (B-3, B-10, and B-11 subsectioned)
- *Representative Location of Composite Bank Sample*
- Supplemental Sample Location
- Automatic Biological Testing Sample Locations
- Property Line (Including Leases)
- Historical Stations

LEGEND

- IT-1 ● Historical Surface Sample Area
- MW-14 ▲ Historical Core Sample Area
- ② Survey Code Reference

SURVEY CODE, SURVEY REFERENCE

1. City of Tacoma (1997b)
2. City of Tacoma (1996b)
3. Environmental Partners (1998)
4. Parametrix (1994a)
5. Parametrix (1993)
6. Hart Crowser (1992b)
7. Parametrix (1988), as cited in Weston (1997b)
8. FS/Tetra Tech (1988)
9. RI/Tetra Tech (1985)
10. Pre-RI Agency Surveys
11. Johnstone (1986) - (See Note 1 Below)
12. Johnstone (1985) - (See Note 1 Below)
13. Parametrix (1996)
14. Ecology (1993)

NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. This data is to be used for reference purposes only.
2. Horizontal Datum: WA state plane south zone (NAD83)
   Vertical Datum: COE mean lower low water
3. Samples not collected in bank segments B-5,B-6, or B-7.

MIDDLE WATERWAY

Preventing the Environmental Poisoning of the Waterway

FOSTER WHEELER AND HARTMAN CONSULTING CORPORATION

Figure 2
Middle Waterway Problem Area
Round 1A and All
Historical Sample Stations

MWWFG04A.DWG

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PLOT/UPDATE: NOV 23 1998 16:29:37

Attachment 3

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

December 2, 1998

Reply To
Attn Of: ECL-115

Kim Maree Johannessen
Johannessen and Associates
5413 Meridian Ave N., Suite C
Seattle, WA 98103-6138

Re: Middle Waterway Remedial Design - Request for Extension to Round 1B Tech Memo

Dear Ms. Johannessen:

I am writing in response to your November 25, 1998 letter requesting a five-week extension to the schedule for resubmitting the above document and also in response to your letter dated November 30, 1998. EPA generally does not approve lengthy extensions without sound justification that the extension is necessary. Your letter does not provide adequate discussion of the impacts such an extension would have to the project schedule, nor does it indicate a compelling need for additional time. I telephoned David Templeton on November 30, 1998, to follow up on the suggestion in my comment letter that we meet to discuss technical approaches and sampling schedule, and offered that such a meeting could affect our understanding of the need for an extension.

It is my understanding, however, that the Middle Waterway Action Committee (MWAC) has declined my invitation to meet this week and that MWAC is now planning on submitting a revised Round 1B Technical Memorandum (Tech Memo) by December 10, 1998, the extended deadline set forth in my November 19, 1998 comment letter.

I am very concerned about your letters' attempt to shift the focus away from the inadequacies of the draft submitted by the Middle Waterway Action Committee (MWAC) on September 28, 1998. Section 4 of the Tech Memo was clearly inadequate in providing a rationale for additional data collection needs. EPA's comment letter dated November 19, 1998, highlighted this inadequacy.

I will not approve the Tech Memo unless I am confident that MWAC's rationale for the locations and parameters of Round 1B sampling makes sense in terms of filling data gaps, i.e., that the combined Round 1A and Round 1B data will provide sufficient information to meet the objectives of the Statement of Work (SOW), including the bulleted objectives set forth on pages 16-17 of the SOW for "Pre-Design Sampling, Analysis and Data Evaluation."

I realize that the comprehensive evaluation of the data collected is part of the Data Evaluation Report to be submitted later. But unless the Round 1A and 1B data collected is

sufficient to meet the SOW objectives, the subsequent data evaluation will not be adequate to provide a basis for EPA's decision on a remediation plan for Middle Waterway.

In addition, several of the specific arguments in your letter are not convincing. For example, your assertions regarding the total number of samples already taken in Middle Waterway has little to no bearing on how many more samples are necessary. In the Summary of Existing Information submitted earlier this year, MWAC was required to compile available historical data and discuss its usability. MWAC elected to discuss the usability of only the most recent data from restoration projects at the head of the waterway. I am not inclined to consider other existing information when MWAC has not fulfilled its obligation to support the use of such data.

Your letter asserts that MWAC will spend far more on sampling than on pre-remedial design and remedial design activities. No documentation is submitted to support your assertion. In the absence of such documentation, I cannot evaluate or respond to the substance of your concern.

Finally, your letter expresses concern that performing biological testing during the latter half of the fall season or during the winter season is problematic. I acknowledged in my November 19 comment letter that the timing for Round 1B sampling may pose problems for bioassays. My letter suggested that MWAC propose a two-phase sampling approach in the next version of the Tech Memo to address this concern. Again, holding a meeting this week might have allowed some resolution of this issue before resubmittal of MWAC's revised Tech Memo.

Please contact Tod Gold at (206) 553-2569 or have David Templeton call me at (206) 553-1215 if you have questions regarding my comments or this letter.

Sincerely,

Ellen Hale
Site Manager

cc: David Templeton (Foster-Wheeler)
Allison Reak (RF Weston)
Helen Hillman (NOAA-EPA)
Bob Taylor (NOAA- Sand Point)
Russ McMillan (Ecology)

Attachment 4

MWAC Response to

EPA TECHNICAL REVIEW

MIDDLE WATERWAY ROUND 1B
TECHNICAL MEMORANDUM

GENERAL COMMENTS

EPA Comment As we have discussed in previous meetings, the document presents limited data evaluation or rationale supporting the data gap interpretation and proposed sampling. Additional discussion and figures showing the distribution of individual or related groups of contaminants would aid interpretation of the results. It may be argued that such details are intended for later inclusion in the Pre-Design Data Evaluation Report, but the Middle Waterway Statement of Work states:

> "The Round 1B Technical Memorandum will identify and provide a basis for additional data collection needs...[and]...include a preliminary discussion of the Round 1A sampling...and will provide an estimate of the volumes of sediment which may require active remediation. In addition, it will identify data gaps, if any, to accomplish the objectives of the AOC and this SOW..." [Note this text is not a word for word quote from the SOW]

Since the Round 1B sampling is intended to conclude all necessary testing to support remedial design, it is important to indicate how each of the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling. At this point, it is unclear that all objectives will be met, as discussed below.

MWAC Response: *MWAC believes that the September 18, 1998 Tech Memo met the objectives of the SOW and that the level of detail requested by EPA is more appropriately presented in the Data Evaluation Report. Clearly, the SOW is designed so that the evaluation and assessment of both Round 1A and Round 1B data to meet the SOW objectives is presented in the Pre-Design Data Evaluation Report, the Evaluation of Remedial Options, and the Recommended Remediation Plan.*

Nonetheless, to address EPA's concerns, the Revised Tech Memo clearly evaluates Round 1A data, identifies data gaps, and describes proposed Round 1B activities. Further, the systematic area by area evaluation includes a list of the key elements of the SOW objectives to assist the reader. A figure has been included, in addition to figures summarizing surface, subsurface, waterway bank segment composite chemical, physical, and biological testing results, that shows the distribution of mercury, LPAHs, HPAHs, and biological testing results. This figure should aid in the interpretation of the Round 1A results.

EPA Comment For example, EPA believes that the proposed sampling does not provide enough lateral or vertical characterization to support remedial design volume estimates for potential remediation areas at the waterway head and potential source areas on banks, to support a demonstration of whether natural recovery is possible or preferable as part of the waterway remediation plan, or to assess the potential for recontamination from bank sources. In addition, contaminant mobility information for sediments which may be dredged at the head, or a demonstration that existing information is sufficient is necessary.

> **MWAC Response**: *The Revised Tech Memo includes an evaluation of Round 1A data to support the rationale behind the proposed Round 1B activities. Round 1B activities are designed to ensure that the key elements of the SOW objectives are met, including the evaluation of the spatial resolution of chemical contaminant distribution, an assessment of the potential for natural recovery of sediments, an assessment of sediment contaminant mobility, an assessment of the potential for sediment recontamination. A demonstration that Round 1A contaminant mobility information will allow for an accurate description of potential water quality impacts during dredging and disposal and the design of such activities is included.*

EPA Comment The proposed sampling plan eliminated analyses for a number of contaminants (such as metals other than mercury, and organics other than PAHs, such as PCBs, certain pesticides, tributyltin (TBT), and furans) in a number of locations, with no rationale. EPA is not willing to rely on indicator contaminants and eliminate other SQO contaminants from analysis unless the contaminant has never exceeded the Sediment Quality Objectives (SQO) in any previous waterway sampling or unless MWAC can demonstrate on a station by station basis to EPA's satisfaction that adequate information has already been obtained. We have already discussed many of the sample locations, and EPA has stated that SQO metals and PAHs are generally necessary at a minimum, and that samples in the vicinity of previous SQO exceedances for other chemicals must address those analytes. Please note that additional data should help in defining cleanup areas and volumes and in reducing the uncertainties of post-cleanup testing.

> **MWAC Response:** *The systematic area by area evaluation of Round 1A data (and historical data where appropriate) is provide to support the rationale behind the selection of Round 1B analytes. Key objectives of the SQO objectives were reviewed during the development of this rationale to ensure that appropriate remedial actions can be evaluated in the Remedial Options Report.*

EPA Comment In order to avoid a third round of sampling, EPA is also open to discussing tiered analysis of archived surface and subsurface samples. Archiving may reduce or eliminate data gaps if the results at the proposed sampling locations for surface sediment chemistry turn out to exceed SQOs.

> **MWAC Response**: *MWAC has included the tiered analysis of archived surface*

and subsurface samples to support the evaluation of the spatial resolution of chemical contaminant distribution.

EPA Comment Biological sampling proposed in the Round 1B Tech Memo does not include benthic sampling or any chronic measure, and is proposed at a limited number of locations without a supporting rationale. In presenting proposed sample locations, it would be helpful to present the rationale for the locations included and omitted. Also, as we have discussed, EPA believes that the Round 1A reference benthic stations were suitable and that benthic data from Round 1A are usable. Additional biological stations should include benthic infaunal analysis. In addition to potentially overriding chemical SQO exceedances, this information may support overall assessments of habitat. Rejection of the Round 1A benthic data would mean that Round 1A benthic locations would have to be resampled.

MWAC Response: *A revised Round 1B biological sampling program has been provided that addresses EPA's desire to have the chronic test be the benthic population evaluation and MWAC's continued concern that interpretation of the benthic population evaluation is complicated by the selection of appropriate reference sites. Further, MWAC believes that either the benthic population evaluation or the Neanthes test will provide information to support the overall assessment of habitat.*

EPA Comment Further discussion should be provided in the report regarding whether the existing and proposed data will support an assessment of the potential for recontamination. Clearly, the proposed bank sampling is intended to assess sources in areas with high mercury concentrations on Foss property banks. However, a systematic discussion is needed (property by property, or area by area, for example) indicating how permitted discharges (at Marine Industries Northwest, Inc. and MI-200), unpermitted smaller outfalls, banks, and other potential sources have been (or will be in Round 1B) adequately characterized for purposes of assessing potential recontamination. Recontamination from subsurface areas should also be considered. Please note that the Washington Department of Ecology (Ecology) Milestone Reports 3 and 4 have been completed for Middle Waterway. MWAC may find Hylebos reports on the potential for recontamination useful in considering what kind of assessment EPA anticipates in future (and, thus, what kind of data may be needed from Rounds 1A and 1B to support the assessment).

MWAC Response: *A systematic, area by area, evaluation of Round 1A data (and historical data, where appropriate) is provided that considers the information necessary for evaluation of recontamination while identifying data gaps and developing proposed Round 1B activities.*

EPA Comment As you are aware, EPA has been working with the City of Tacoma on further characterization of dioxins in sediments in and near the Olympic View Resource Area. To assess whether dioxins are found at elevated levels within Middle Waterway,

we would like MWAC to collect samples near the former Coast Craft facility, which was identified as a potential source of dioxins in a recent Ecology report.

> **MWAC Response**: *MWAC is willing discuss the collection selected sediment samples near the former Coast Craft facility and adjacent to waterway bank segment B-3b. EPA and MWAC will need to discuss when, and if, these samples are submitted for the analysis of dioxin, how the results will be reported, and how the results will be evaluated.*

EPA Comment EPA acknowledges that the timing for Round 1B sampling may pose problems for bioassays. Bioassays conducted at this time of year often result in ambiguous data due to reference mortalities. EPA would consider a two-phase sampling approach in the next submittal of Tech Memo 1B, which would call for as much field work as possible this fall, but would allow for biological testing in early spring.

> **MWAC Response:** *Late fall and winter pose an issue for both biological and benthic population evaluations, particularly in a mudflat environment that is exposed during low tide conditions. Further, significant safety issues exist during the night time collection of bank samples (required to coincide with sufficiently low tides) and sample collection during winter storms. MWAC proposes to perform all Round 1B chemical and biological synoptically as early in the Spring as possible, pending EPA approval of the Round 1B Tech Memo.*

EPA Comment MWAC has seen a draft copy of these comments, and EPA has had several opportunities to discuss options with MWAC in technical meetings. I would like to propose that MWAC now prepare a revised proposal by providing an updated Figure 14, Table 15, and phasing schedule for discussion by December 1. The figure would be a focal point for discussion at a meeting during the week of November 30, and rationales could be provided verbally in anticipation of including them in the revised Tech Memo.

> **MWAC Response**: *Even though MWAC met with EPA on several occasions to discuss EPA's comments, EPA's November 19, 1998 comments did not reflect any progress in resolving outstanding issues. As stated above, MWAC believes that the September 18, 1998 Tech Memo met the objectives of the SOW and that the level of detail requested by EPA is more appropriately presented in the Data Evaluation Report. Nonetheless, to address EPA's concerns, MWAC has revised the Tech Memo to include an evaluation of Round 1A data, identifies data gaps, and describes proposed Round 1B activities. The submittal of a updated Figure 14 and Table 15 four working days (comments provided on the Friday before Thanksgiving) after receipt of EPA comments was unreasonable. Further, given the ineffectiveness of previous meetings in coming to resolution, EPA's stated preference not to meet before submittal, and the fact that MWAC had only 12 working days to develop, produce, and submit a Revised Tech Memo to EPA, a meeting with EPA during the week of November 30, 1998 was not the best use of MWAC's response period.*

With submittal of the Revised Tech Memo and review of EPA's written comments, MWAC looks forward to sitting down and constructively coming to a mutually agreeable Round 1B sampling and analysis program.

SPECIFIC TECHNICAL COMMENTS

1. **Page 1-1, Section 1.2, Second Paragraph.** The tech memo's purpose and scope differs from the language used in the Work Plan and SOW in that the text referring to discussion and interpretation of results has been omitted. To better reflect the language and expectations in the Work Plan and SOW, additional text is recommended: insert "preliminary discussion and" before "summary of Round 1A sampling; insert "based on biological, sediment chemistry, and contaminant mobility tests" after "analysis results"; and insert "and provide a basis for additional collection needs" after "identify data gaps."

   Response: The text will be revised to reflect the wording provided in the SOW and Work Plan.

2. **Page 2-1, Section 2.1, Third Paragraph**. Please note the elevation of the shoreline/top of bank that is outlined on all figures.

   Response: Notation has been added to Section 1.1.

3. **Page 2-1, Section 2.1, Third Paragraph** For clarity and to set the stage for proposed Round 1B sampling, the addition of a few sentences on the rationale behind the initial sampling location selection and analytical choices would be helpful (e.g., state why sixteen stations were analyzed for TBT pore water and why those locations were selected; state why MW021 and MW054 were selected for TAL testing).

   Response: The Round 1A rationale is provided in the EPA-approved Work Plan and SAP and is not repeated in the revised Tech Memo. The Round 1B strategy is supported, as appropriate, with a discussion of historical and Round 1A data results in Section 4.

4. **Page 2-1, Section 2.1, Fifth Paragraph.** At a September 24, 1998, meeting, WESTON requested that bank sample elevation ranges be added to the sampling forms or a table. Please include this information in the revised tech memo.

   Response: Bank sample elevation ranges were added to forms presented in the Round 1A Data Report, based on an earlier EPA request, and will be repeated in the Round 1B Technical Memorandum to assist EPA in their review.

5. **P. 2-2, Section 2.2.1, First Paragraph.** Please include the detection limits in Table 2.

   Response: Table 2 (and Tables 3 and 4) is designed to present chemical concentrations that exceed the SQO. Chemicals that are undetected above the SQO have been added to the tables.

6. **Page 2.2, Section 2.2.1.1, First Paragraph**. Please discuss the rationale for focusing on

exceedence ratios of 3.0 and 5.0 for mercury. If applicable, these ratios should also be discussed for the other chemicals exceeding SQOS. Please discuss the precedent (e.g., other waterway remedial actions) and the scientific basis (e.g., do other sites show natural recovery for chemical concentrations less than 3.0 times the SQO—for all chemicals? Are sediments exceeding an ER of 5.0 more likely to require dredging, rather than in-place capping?).

Response: These exceedence ratios were chosen to assist the reader in understanding the relative magnitudes of mercury exceedences in the surface sediments.

7. **Page 2-3, First Paragraph.** Please add definitions for all data qualifiers in Tables 2 and 3, and include those qualifiers in Figs. 3, 4, and 5.

   Response: The data qualifiers are defined in Tables 2 and 3. Figures 3, 4, and 5 show exceedence factors not concentrations. It is inappropriate to add qualifiers to exceedence factors as they qualify *concentrations*. Figures 3, 4, and 5 have been updated to include the undetected compounds that have detection limits greater than the SQOs. These compounds are identified by a "U" following the EF.

8. **Page 2-4, Second Paragraph.** It would be appropriate to discuss potential sources of N-nitrosodiphenylamine in this tech memo. Are decomposed rubber tires (from tug/pier bumpers and cars/trucks via street runoff) a potential source?

   Response: MWAC will discuss potential sources on N-nitrosodiphenylamine in the Pre-Design Data Evaluation Report.

9. **Section 2.2.2, First Paragraph.** Please confirm that the results presented in Fig. 4 are for 20 stations, not 16, and that 16 of the stations were sampled in 1998. Please explain why the MW030 subsurface interval between 5.5 and 7 ft is not reported on Fig. 4. Briefly discuss the data comparability between 1995/1996 samples and Round 1A samples, if this has not been done in previous documents.

   Response: The text has been edited to reflect that 16 stations were sampled in the Round 1A sampling event and 4 additional locations that were sampled in 1995 and 1996 are also included on Figure 4. The 5.5 to 7-foot interval from MW030 was not submitted for chemical analysis and therefore there are no results to report on Figure 4. The data from 1995 and 1996 presented in the Tech Memo are treated as part of the data set. The Round 1A sampling event did not re-occupy any of the 1995 or 1996 stations, therefore a discussion of comparability is inappropriate.

10. **Page 2-5, Section 2.2.2.2, First Paragraph.** Based on Fig. 4, in the mouth of Middle Waterway LPAHs were also found at MW024 and MW031 (in the upper intervals), indicating more extensive distribution than just MW027 and MW030. Please discuss how the existing data or proposed sampling will address verification of the horizontal extent of these LPAHs.

    Response: This comment implies that there is a connection between stations MW024, MW031, MW027, and MW030. Cores MW026 and MW029 do not have SQO exceedences at depth. MW031 is located on the opposite side of the waterway from MW027 and MW030, completely isolated from these locations. The biological tests performed on the surface sediments at MW024 confirmed that the concentrations of SQO

analytes are not associated with adverse effects. To evaluate the potential for adverse effects at stations MW027 and MW030, MWAC proposes to perform biological testing of the surface sediments during Round 1B. In addition, to further delineate the horizontal and vertical extent of the SQO exceedences, if necessary, MWAC proposes to collect and archive two additional cores located between MW027 and MW030.

11. **Page 2-8, Section 2.2.3.2. First Paragraph.** From this point, roughly 10 percent of the reported data were checked for accuracy against the tables. Given the number of errors or discrepancies to this point, (and listed under "Editorial Comments") please verify 100 percent of the remaining data reported in the text and correct any discrepancies.

    Response: The data in the text, figures, and tables has been updated to reflect the final validated data set. These data were not available for the original submission on the revised Tech Memo.

12. **Page 2-15, Section 2.5.1.2, First Paragraph.** Please provide a discussion of the relevance of each benthic community analysis failure. As requested during the 24 September 1998 meeting, please provide a figure displaying biological test results similar to the figures depicting chemical results.

    Response: The section and paragraph referred to in the comment discusses the methods used to perform benthic analyses. It is inappropriate to discuss the "relevance of each benthic community analysis failure" in this section. An evaluation of the benthic testing results is included in Sections 2.5.7 and 2.5.8. Figure 16 of the revised report includes biological testing results.

13. **Page 2-16, Section 2.5.2, First Paragraph.** Given the apparent failure of both MW208 and MW209 to meet performance standards, please explain why MW210 was not evaluated.

    Also, please provide the rationale for benthic community analysis sampling locations, which were selected after the work plan.

    Response: As discussed in the text and as shown in Table 7, station MW208 met all the appropriate performance criteria and is used for all comparisons. MW210 was not analyzed with this test as the grain size at the two stations analyzed were representative of the test stations and the grain size at this station (71.1%) was outside the range of the test stations. Analysis of *Neanthes* or benthic community sampling locations was negotiated with EPA on June 30, 1998, as described in Section 2.5.

14. **Section 2.5.3, Third Paragraph.** Regarding Table 13, Tables 4A and 4B from the SOW or Tables 24 and 25 from the Work Plan provide more appropriate descriptions of the biological effects interpretive criteria, rather than the Washington State Sediment Management Standards criteria, which (although similar) do not directly apply to this site.

    Response: Comment noted. The table has been revised to reflect this comment.

15. **Page 2-17, Sixth Paragraph.** [Last sentence of paragraph continued on p. 2-18] This sentence should be reworded to indicate that, "...of the ten stations analyzed for benthic effects, station MW039 requires active remediation."

Response: The text of this section has been revised.

16. **Page 2-18, First Paragraph**. Rationale should be provided for using one composite sample to represent the potential dredge prism (as discussed briefly in the sediment geology section). Is the adequacy of this information affected by the results of sampling in the waterway head?

    Response: Rational and an evaluation of existing information necessary to address this comment is provided in Section 4.11 of the revised Tech Memo.

17. **Page 4-1, Section 4.2**. Figure 14 is difficult to read and should be revised/clarified so that proposed stations are distinguishable from previously sampled stations.

    Response: The figure has been modified and revised to reflect this comment.

18. **Section 4.2.1, First Paragraph**. The assumption that the City of Tacoma will address intertidal and subtidal areas of the Middle Waterway has not been confirmed or substantiated with any supporting information in this report. In the Work Plan, the City's commitment to remediation is described as applying to the "higher intertidal," not below the banks. This paragraph should reflect the City's most recent discussions with MWAC and EPA to define the project area and confirm that MWAC will coordinate with the City to ensure that potential contaminant sources will be addressed.

    Response: MWAC has met with the City of Tacoma and this section has been revised to reflect the content of that meeting. MWAC proposes further sampling to fill data gaps in this area, which will support the evaluation and selection of an appropriate remedy.

19. **Section 4.2.2, First Paragraph**. The rationale and justification for defining "elevated" chemical levels were neither defined nor discussed. It appears that PAHs (and mercury) have become the analytical surrogate COCs for Table 8. Omitting SQO's from the list of analytes requires extensive justification, as discussed in the letter. Please provide documentation of the rationale, based on the outcome of discussions following these comments.

    Response: The term "elevated" was used to refer to concentrations that exceed the SQO. Section 4.0 of the document has been extensively revised to include a systematic, area-by-area evaluation and discussion of how the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling.

20. **Section 4.2.2, Second Paragraph** Please explain why mercury was not included for the Round 1B five proposed surface samples, yet mercury exceedances at MW-1 and MW051 are in the area (MW050 and MW051) that is proposed for additional sampling. Given exceedences for PCBs and pesticides at MW008-SP, a benthic community test failure at MW049, and the proximity of MW105 to these two stations, please discuss why PCBs and pesticides were not included in the proposed analyses for MW105. Please explain the rationale for locating the five proposed surface sediment stations in a circle around MW107. What is the rationale for locating MW102 between MW051 and the bank? Please explain the rationale for collecting shallow subsurface cores to a maximum depth of 3 feet, when previous samples to 2 feet had SQO exceedences. It appears that the subsurface cores are focused on the vertical extent of PAH contamination west of MW050, but not to the north, south, or east. Please explain the rationale for this station positioning.

Response: Section 4.0 of the document has been extensively revised to include a systematic, area-by-area evaluation and discussion of how the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling.

21. **P. 4-2, Section 4.2.3, First Paragraph**. Please define the levels of SQO exceedences that trigger the need for further delineation and state the rationale (e.g., "...sediments with SQO exceedences greater than a factor of 2 would not be expected to recover naturally to acceptable chemical concentrations in a ten-year period, based on site sedimentation estimates and studies in similar estuarine areas such as ___. Therefore, SQO exceedences greater than __ will require further definition before remedial activities are determined.").

Response: Section 4.0 of the document has been extensively revised to include a systematic, area-by-area evaluation and discussion of how the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling.22. **P. 4-2, Section 4.2.3, Second Paragraph.** Please clarify why mercury (and other) chemical exceedences greater than three times the SQO along bank sections 10a and 10b were not considered further. Please define the rationale used to justify no further chemical analyses for copper, lead, zinc, and arsenic (where chemical results exceeded a factor of two times the SQO). Please explain how the proposed samples MW112 and MW113 will further define the horizontal extent of COCs (especially mercury) between the abandoned barges and MW042, MW043, MW045, MW048, and MW049. Please discuss how the 2-foot-depth of proposed shallow subsurface samples will further delineate the vertical extent of mercury contamination (found to a depth of 3.5 ft at MW040). Please explain why pesticides and PCBs, present in bank samples at MW008-SP (and adjacent to MW049, where a benthic analysis failed), were not included in the Round 1B analytes for bank segments. Please state the rationale for determining which selected samples will be analyzed or archived.

Please state the rationale for the cluster of surface sediment sampling stations around MW032 and MW035. These samples seem to offer little additional horizontal definition to the mercury contamination found around/throughout the MW029 through MW032 area. Please clarify figure so that proposed station MW32 (near MW029, Fig. 14) is clearly recognizable as MW132. Please explain why a gravity core sample is proposed between MW028 and MW031, but not south beyond MW035 (where diethylphthalate was found to a depth of 8 feet with an exceedence factor 5.5 times the SQO). Please justify the maximum core depth of 4 feet, although COCs were found to a depth of 8 feet.

Response: Section 4.0 of the document has been extensively revised to include a systematic, area-by-area evaluation and discussion of how the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling.

23. **P. 4-3, Section 4.2.5, Third Paragraph**. Please explain why copper is not proposed for analysis, although elevated levels (2.79 times the SQO) were found along the bank near Segment 13. Please explain rationale for placement of the proposed stations around MW025, including bank samples. Please explain how the horizontal extent of COCs will be determined between MW139, MW136, and MW020. Please explain the rationale for defining the horizontal extent of mercury found along the bank of segment B-12 between MW137 and MW028. Please explain if the vertical extent of COCs in this area will be defined by the vertical extent (to a depth of 5 feet) of mercury at MW025.

Response: Section 4.0 of the document has been extensively revised to include a systematic, area-by-area evaluation and discussion of how the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling.

24. **Section 4.2.6, Third Paragraph.** Please state the rationale for co-locating six additional bioassay stations at those locations. Please state the rationale for classifying an EF less than 2.5 as "slight" and thus performing acute bioassays at those locations, but not at others. Please explain the method for defining the horizontal and vertical extent of PCBs in MW03a.

    Response: Section 4.0 of the document has been extensively revised to include a systematic, area-by-area evaluation and discussion of how the SOW objectives will be met by the combination of existing data and proposed Round 1B sampling.

25. **Page 5-1.** This section does not contain the "elements of a natural recovery demonstration" as specified in the Work Plan. In lieu of a natural recovery framework, a detailed discussion of why natural recovery is unsuitable should be developed. Perhaps a technical meeting specific to the utility and possibility of natural recovery should be proposed by MWAC at this time.

    Response: This section has been revised to reflect this comment.

In addition to the tech memo data report, WESTON briefly reviewed *Preliminary Estimates of Dredge Volume and Contaminant Mobility Test Results in Support of Combined Disposal* (Foster Wheeler and Hartman Consulting Corp. 1998). In general, the report is a data presentation with no evaluation or interpretation of results. The final report should include significantly more detail and discussion. Specific comments follow.

Response: This amendment is not an EPA required deliverable and was not included for critical review. Rather, it was intended to provide EPA with a preliminary estimate of potential volumes that may require active remediation for purposes of combined disposal. It was MWACs intent to demonstrate our commitment to a timely and cost-effective cleanup for our and all the CB/NT sediments requiring contained disposal by providing this information at such an early point in our pre-remedial design process. This appendix has been removed from the revised Tech Memo.

26. **Section 2.2, First Paragraph.** Clarify whether 20 or 34 subsamples were collected within the tideflat and subtidal area.

    Response: Comment noted. This appendix has been removed from the revised Tech Memo.

27. **Section 3.2.** Please state that the surface and bank data exceeding SQOs were not included in this evaluation. Please clarify that subsurface SQO exceedences in the middle and head of the waterway (from centerline survey station 15 to 21, and from 22 to 42) were not included in the evaluation or dredge volume estimates.

    Response: Comment noted.

28. **Section 3.1.** Please provide an estimate of the volume expansion expected with dredging. This volume will be critical in determining dredge disposal options.

Response: Comment noted. This appendix has been removed from the revised Tech Memo.

29. **Section 4.0.** Please provide a complete discussion of how the composite sample was created. Describe how it was determined that the composite was representative of the potential dredge prism and specify sections of cores that were combined.

    Response: This comment is addressed in Section 4.11. This appendix has been removed from the revised Tech Memo.

30. **Section 4.4, First paragraph.** The purpose of defining the characteristics of the mixture of all the sediment is not clear. The entire mass of placed sediment will not be mixed. As the sediment is dredged and placed it will retain its characteristics.

    Response: Comment noted. This appendix has been removed from the revised Tech Memo.

31. **Section 4.4, Second Paragraph**. It is assumed that the second sentence refers to clamshell dredging. Please clarify the type of dredging. In the last sentence, please indicate that an option to water treatment may be incorporation of a sufficiently large retention pond to allow particulate to settle.

    Response: Comment noted. This appendix has been removed from the revised Tech Memo.

32. **Table 1**. Include units with the concentration heading. Clarify if the absence of values in the table indicates that there were no exceedences or if no analysis was performed.

    The exceedence factors do not match those shown on Figure 4 in the report. For instance, at MW-24, Table 1 shows an exceedence of 1.08 for Fluoranthene and Figure 4 shows 2.64. Several other discrepancies have also been noted. The samples used for the composite were mostly from the north end of the waterway. Samples from the south end, such as TF-22 have significantly higher PAHs. Its likely that the resultant PAH concentrations may be low.

    Response: This appendix and the table have been removed from the revised Tech Memo. The revised table will be provided in the Round 1A Data Report. Section 4.11 addresses the representativeness of the composite sample.

33. **Table 2**. Discuss how the results for the Thea Foss Waterway are pertinent to the disposal evaluation in this report.

    The concentrations of PAHs in the mobility tests are much lower than the average for the waterway. This should be factored into the conclusions when the DRET and MET data are reviewed.

    Response: See response to Comment 32. This appendix has been removed from the revised Tech Memo.

34. **Table 4.** Provide plots of analyte concentration versus pore volumes eluted so trends can be more readily observed.

Response: MWAC intends to present the evaluation and assessment of sediment contaminant mobility in the Data Evaluation Report. This appendix has been removed from the revised Tech Memo.

35. **Attachment 1.** The particle size distribution for the material used to perform these tests should be provided. State which samples or sample locations were used to perform the settling tests. Settling tests should be run on several different samples representing the range of expected grain size. These tests would allow an estimation of what portion (volume) of the sediment is likely to be problematic for meeting water quality standards.

    Response: This information will be provided with the Round 1A Data Report. This appendix has been removed from the revised Tech Memo.

36. **Graph 2.** Provide a footnote indicating what parameter is being presented and what the initial concentration was.

    Response: Comment noted. This appendix has been removed from the revised Tech Memo.

EDITORIAL COMMENTS

1. **Page.2-1, Section 2.1, Paragraph 4**. What does "(MW053)" refer to? Should the reference to Section 4 be changed to Section 2.6?

    Response: The sediment from station MW053 was submitted for chemical analysis based on the TAL constituents. All other subsurface samples were submitted for chemical analysis based on the SQO list. The reference to Section 4 has been changed to Section 2.11.

2. **Page 2.2, Section 2.2.1.1, First Paragraph**. Remove "only" from the phrase "only two samples had exceedence factors greater than 5.0." Based on Figure 3, please confirm that 14 (not 15) of the 21 samples had exceedence factors of less than 3.0.

    Response: The text has been modified to reflect this comment.

3. **Page 2-2, Section 2.2.1.2, First paragraph.** Fluorene is misspelled in Fig. 3 at MW028.

    Response: The figure has been modified to reflect this comment.

4. **Page 2-3, First Paragraph.** Based on Figure 3, please confirm that 5 (not 6) benzo(a)anthracene samples, 4 (not 5) benzo(a)anthracene samples, 7 (not 8) fluoranthene samples, 4 (not 5) indeno(1,2,3-cd)pyrene samples, and 1 (not 2) dibenzo(a,h)anthracene samples (no EF is shown for TF-23 in Fig. 3 or Table 2) exceeded the SQO. Benzo(g,h,i)perylene is misspelled in Fig. 3 at TF-23. [Please add definitions for all data qualifiers in Tables 2 and 3, and include those qualifiers in Figs. 3, 4, and 5.]

    Response: The text has been modified to reflect this comment. The data qualifiers are defined in Tables 2 and 3. Figures 3, 4, and 5 show exceedence factors not concentrations. It is inappropriate to add qualifiers to exceedence factors as they qualify *concentrations.*

Figures 3, 4, and 5 have been updated to include the undetected compounds that have detection limits greater than the SQOs. These compounds are identified by a "U" following the EF.

5. **Page 2-3, Third Paragraph.** Based on Fig. 3, please confirm that two (not one) total PCBs samples (see TF-23) exceeded the SQO.

   Response: The text has been modified to reflect this comment.

6. **Page 2-4, Second Paragraph.** Phenol was reported in the previous section on phenols.

   Response: The text has been modified to reflect this comment.

7. **Section 2.2.2, First Paragraph.** Please confirm that the results presented in Fig. 4 are for 20 stations, not 16, and that 16 of the stations were sampled in 1998.

   Response: The text has been modified to reflect this comment.

8. **Page 2-5, Section 2.2.2.2, First Paragraph.** Please confirm that the greatest concentrations of the LPAHs anthracene (exceedance factor of 6.56), naphthalene (exceedence factor of 5.24), and 2-methylnaphthalene (5.24) were found at MW050, not TF-22. Please confirm that the greatest exceedence factor for fluorene was 48.00 (not 10.74) in the second interval at TF-22.

   Response: The text has been modified to reflect this comment. The text did state that the greatest EF for naphthalene is 5.24. The greatest EF for 2-methylnaphthalene is 4.63 as the text stated, not 5.24 as stated in the comment.

9. **Page 2-6, First Paragraph**. Based on Figure 4, please confirm that 8 (not 7) benzo(a)anthracene samples exceeded the SQO by a maximum factor of 20.00 at TF-22 in the second interval. Please confirm that dibenzo(a,h)anthracene exceeded the SQO by a factor of 20.00, not 22.00. Please confirm that 10 (not 8) samples exceeded the SQO for fluoranthene. Please confirm that 9 (not 8) samples exceeded the DQOS for pyrene and total HPAHs.

   Response: The text has been modified to reflect this comment.

10. **Page 2-7, First Paragraph**. Based on Fig. 4, please confirm that 2,4-dimethylphenol exceeded the SQO at four (not three) stations, including MW050.

    Response: The text has been modified to reflect this comment.

11. **Section 2.2.3, First Paragraph**. Please clarify the first sentence so that the 25 samples reported on Fig. 5 can be reconciled with the 21 locations mentioned in the text.

    Response: The text has been modified to reflect this comment.

ADDITIONAL EPA COMMENTS:

1. Page ii - Update appendix list

   Response: Comment noted.

2. Page iii - Update list of figures

   Response: Comment noted.

3. Page 2-13 and 2-14 - Section 2.4 Sediment Geology - The "practical implications" discussion at the end of this section is a little inconclusive. This section should indicate whether a visual or other distinction could be made between pre-contamination sediments and more recent layers. Does native sediment always occur below a certain elevation? Would sediments from a deeper layer be expected to be clean, unless a subsurface pathway exists? These questions could help limit coring depths or assess how contamination came to be in the deeper sediment layers, and whether there are ongoing subsurface inputs which could lead to recontamination. Does the discussion of sediment geology have any bearing on biological effects? Does contamination tend to be found in association with one or another type of geological material? Note when stating the conclusions that without further information, the conclusions do not apply to sediments in the waterway tideflats.

   Response: The practical implication discussion has been deleted from the revised Tech Memo. A complete evaluation of the geologic data from Round 1A and 1B will be provided in the Data Evaluation Report.

4. Page 2-15 Section 2.51.2 Benthic Community - It is unclear why, if all benthic reference stations are said to fail the criteria in Tables 24 and 25 of the Work Plan, only the stations that would fail are designated as inconclusive (TBD). It does not appear that MWAC wishes to reject the entire data set. EPA believes it is acceptable to use the Hylebos reference stations as they are presented, based on habitat characteristics and community composition. The "fail" designation should be retained for Stations MW39 and MW49, but Station MW54 should be considered a "pass". This is based on an evaluation of the benthic data provided by MWAC separately from the Technical Memorandum. The evaluation is provided as Enclosure A to this letter.

   Response: The discussion of the biological testing has been revised and the figure has been updated to reflect the interpretation provided.

5. Page 2-18 - Section 2.6 Contaminant Mobility Results - This section should provide a summary statement or statements regarding what the contaminant mobility tests showed. Note that EPA has not seen adequate justification for viewing the tested sediments from the mouth as representative of potential dredge volumes in the head of the waterway. For example, if PAH sources areas at the head are to be dredged, will the PAH concentrations be comparable to those at the mouth? Are the grain sizes similar? This may be a data gap which requires further testing. Perhaps archiving samples from cores in Round 1B would allow later testing without a separate field effort.

   Response: The predictive accuracy of the contaminant mobility testing results is discussed in Section 4.11.

6. Page 3-1 - Estimate of Sediment Volume that May Require Active Remediation - The specific limitations of the estimate referenced should be discussed. For instance, the fact that the dredge volumes do not include sediments at the head should be mentioned. Are the proposed tests intended to support NOT dredging sediments at the head? As a related issue, we are uncertain if MWAC intends to use further testing in the preliminary dredge area at the mouth of the waterway to reduce the dredging volumes--but we note that certain samples (for example, the core at Station 133, Station 132) seem designed to do so. Please provide a rationale.

   Response: The Tech Memo has been revised to address these concerns.

7. Page 4-1 - Section 4.1 - Geotechnical Data - Please add "Gaps" to heading. Also, state why additional geotechnical data are not needed at this time. Is there another time that such information may be needed? How would the information gathering be worked into the schedule and process? What are the implications of the information provided in Appendix A.

   Response: Geotechnical data gaps are addressed in the area-by-area evaluation presented in Section 4.

8. Page 4-1 - Section 4.2 - Pursuant to our recent discussions with the City of Tacoma project lead for the restoration project, please modify. The city has not clearly indicated that they will be addressing the area as a potential source. Continued discussions will be necessary as the project is further defined. In addition, the project boundaries have been clarified, leaving a larger area within the purview of Middle Waterway remedial design.

   Response: MWAC has met with the City of Tacoma and this section has been revised to reflect the content of that meeting. MWAC proposes further sampling to fill data gaps in this area, which will support the evaluation and selection of an appropriate remedy.

9. Page 4-1 - Section 4.2.2 - Section 4.2.6 - Please note that subsurface conditions may have to be examined regardless of whether the surface sediments are clean or whether, despite contamination, biological effects are not shown. The reason for such an examination is that the subsurface contamination may pose a threat of contaminant migration upward or may be exposed through erosion. This potential should be discussed. Note also the following:

   - benthic evaluations are still considered appropriate for the chronic measure of biological effects;

   - biological testing must be accompanied by conventional sediment analyses at a minimum, and EPA recommends chemical testing to help understand the reason for test failures (Please describe the likelihood of collecting biological test sediments within sufficiently close range of previous chemical tests to represent previously tested conditions);

   - while mercury and PAHs may predominate in an area, contaminants that occur sporadically in banks, surface, and subsurface samples cannot be overlooked without further discussion of potential sources and pathways, and in most cases further analysis;

   - in areas where sampling is still widely spaced, we recommend refining sediment volumes through additional sampling to avoid a large volume of sediment being

represented by limited data; the reason for the depth of the shallow cores proposed should be better supported or deeper cores planned for;

- do the bank samples along the Marine Industries and General Construction shoreline need to be as closely spaced? would it be more productive from a design standpoint to focus more on potential subsurface and lateral contamination in the waterway? could other information such as a few upland soil samples, a field survey or review of operational history help yield an upland source?

- do the samples proposed around station 25 adequately represent potential depth and lateral distribution of contamination? Perhaps archiving samples from greater depths and distances from 25 would be advisable.

- is there no further sampling proposed of the boat ramp (near Station 11a-SP) because the area is going to be added to a dredge prism? Please discuss.

- are chemical data needed near 4b-SP to determine what actions may be needed?

- why is no additional biological testing proposed at sample locations on the west side of the centerline?

- by focusing on shallow samples near "hot" stations, are you assuming that the material was deposited through sediment transport? If so, you might overlook contamination present in the subsurface due to groundwater transport or direct dumping.

- why are the cores near stations MW50 and MW51 shallow?

- what might have caused the benthic impacts near Coast Craft? Have TICs been reviewed?

- what pathways might have led to subsurface contamination near the head?

We encourage you to consider these points and discuss them with EPA at the proposed meetings.

Response: Comment noted. Please see MWAC's response to EPA's general and specific comments that address these and similar issues.

10. Page 5-1 - Section 5 - Natural Recovery Approach - This section was lacking in substance. Now is the time to determine whether MWAC will accept the chemical evidence or challenge it through biological testing, or seek to assess natural recovery as a possibility. How will areas for which natural recovery may be appropriate be determined if not through sampling or other evaluation at this stage? What information is needed to make that determination? At a minimum the document should state whether natural recovery is an appropriate proposal for broad categories of sediments or general areas which MWAC intends to dredge. It may be useful to refer to the SRAL information developed in the ROD, which states preliminarily that stations failing the SQO by a factor of less than 1.2 may be capable of natural recovery. Are there areas that fit that description? Is there a way to discuss what the mechanisms of natural recovery would be in this setting?

Response: The text has been revised to address this comment.

11. Page 7-1 - Section 7 - References - This list seems incomplete. Other studies whose data are presented here should be listed, as well as the ROD and RD SOW. We discussed the potential availability for more current data from the Simpson monitoring of the shoreline restoration site. Please include relevant information and reference the report if available.

    Response: The text has been modified to reflect this comment.

12. Figures - We discussed the presentation of a more summary list of chemicals (such as LPAHS, HPAHs and mercury), and a draft was presented briefly at a meeting in early October. Including this in a document revision would be of use. In such a figure, including both bank and surface samples would also be helpful. Figure 14 continues to be difficult to read. Reviewers should be able to distinguish past from proposed samples. Can the figures be marked to show areas potentially linked by a given pathway to a potential source area? This may be useful in supporting the proposed further sampling and the selection of analytes.

    Response: A summary figure was presented to EPA following the submission of the original Tech Memo and was included in the Executive Summary of the Round 1A Data Report. This summary figure has been included in the revised Tech Memo. The figure (former Figure 14) has been revised to reflect this comment. Evaluation of potential pathways or sources will be performed in the Data Evaluation Report.

Attachment 5

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

July 7, 1999

Reply To
Attn Of: ECL-115

SENT BY CERTIFIED MAIL
RETURN RECEIPT REQUESTED

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-and-

David Templeton
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Re: EPA comments on Second Draft Round 1B Technical Memorandum (dated December 10, 1998) and Draft Round 1A Data Report (October 27, 1998)

Dear Ms. Johannessen and Mr. Templeton:

EPA has had an opportunity to review the above documents and, after several meetings and discussions this spring, is providing comments by this letter. Other reviewers include EPA technical consultants at Roy F. Weston, Inc., Russ McMillan of the Washington Department of Ecology, and the U.S. Army Corps of Engineers. After the first draft in September 1998, the revised technical memorandum moved significantly closer to an approvable document. Expansion of the rationale helped clarify MWAC's expectations and goals for the sampling proposed. I believe with some final changes to the document, we will be able to proceed with the final phase of pre-remedial design sampling.

Because we have thoroughly discussed our points of difference, at this point EPA anticipates that MWAC will make the required changes to sample locations, type of sample, proposed analytes, and analytical tiering so that work to support combined disposal will be completed in time.

EPA provided draft comments on the data report based on a 10% review, and to address EPA concerns that the remainder of the report might have similar problems, MWAC's consultant completed a 100% QC review of the document. MWAC shall resubmit the full Round 1A Data

Report with the corrections shown in recently submitted draft page revisions and with the additional data recently received from contaminant mobility tests. The Round 1A Data Report ma[redacted] revised Round 1B Technical Memorandum to avoid duplication of info[redacted]

Regarding the timeframe for revisions to the Round 1B Technical Memorandum and Round 1A Data Report, EPA approves a 45-day turnaround time for the combined revisions. MWAC shall also submit a draft SAP/QAPP addendum within 30 days of MWAC receipt of this letter, as elements of Round 1B sampling have not been detailed. If MWAC wants an earlier field start, EPA would welcome at the same time a revised figure of proposed sampling locations with the associated table of proposed analyses and tiering at each location for advance review, and potentially approval for field work.

MWAC has also requested (in meetings and, most recently, in the June 10, 1999 progress report) a period of 180 days (rather than 120) to report the Round 1B data and prepare the Pre-Design evaluation report. EPA is concerned that MWAC efforts to combine disposal of Middle Waterway sediments with sediments from other waterways may be hampered, particularly in light of the protracted period of review and discussion of Tech Memo 1B technical issues and the two-tiered analytical approach for Round 1B. EPA will consider an extension to the submittal timeframe of the Round 1B Data Report and Pre-Design evaluation report, but approval of such an extension will necessarily be based on the impact to the Middle Waterway schedule relative to the other waterways. Please provide an updated project schedule showing the anticipated effect of such an extension through RD and be prepared to discuss timing with respect to Thea Foss disposal site decisions and design.

Please contact Ted Yackulic at (206) 553-1218 or have David Templeton call me at (206) 553-1215 if you have questions regarding my comments or this letter.

Sincerely,

Ellen Hale
Site Manager

Enclosures

cc: ~~David Templeton (Anchor)~~
Allison Reak (RF Weston)
Helen Hillman (NOAA-EPA)
Bob Taylor (NOAA- Sand Point)
Russ McMillan (Ecology)

EPA comments on revised Technical Memorandum 1B (dated December 10, 1998)

GENERAL COMMENTS

At the SQOs: The definition of "at" the SQO is not 2X or less, but is 1X SQO. Given the analytical uncertainty, EPA may consider certain values sufficiently close to the SQO not to trigger active cleanup on a case by case basis, but anything greater than 1X SQO should be described accurately in the text.

PCBs: Where PCBs exceed the SQO, biological testing will not obviate the need to address the contaminated sediments. Examples of stations where this may be an issue are MW03a, TF-23, and MW008-SP. Such areas should be included on the figure describing potential remediation areas. Also, vertical distribution of PCBs in these areas should be characterized.

Synoptic Biological/Chemical Data: EPA prefers that biological tests be done synoptically with chemical analyses. Synoptic testing helps assess the potential causes for biological failures. In the MWAC response to EPA Technical Review, it is stated "MWAC proposes to perform all Round 1B chemical and biological [testing] synoptically as early in the Spring as possible." We understand that this is an error. Table 16 of the Tech Memo proposes biological tests only at stations previously sampled for chemistry.

As David Templeton clarified at a meeting, the biological test sediments can be collected within ±5' of the original chemical sample locations. With this understanding, EPA will accept biological testing at previously sampled stations without further chemical analyses. Please note, however, that biological results from non-synoptic sampling stations cannot be correlated to chemical concentrations to predict biological conditions elsewhere. If MWAC does not gather biological data to override a known surface SQO exceedance, the chemical findings will prevail, unless EPA determines otherwise on a case-by-case basis.

Biological testing - Chronic measure: As you are aware, MWAC and EPA disagree on the selection of reference stations for comparison to Round 1A test stations. EPA reaffirms its previous position with respect to interpretation of the Round 1A results. Differences in TOC are not sufficient reason to reject stations in Hylebos waterway which are otherwise comparable in terms of depth, grain size, and community structure. Moreover, suitable reference stations are available for almost all of the locations for which biological testing is proposed in Round 1B. Most of the Round 1B biological testing proposed by MWAC still relies on the *Neanthes* growth test, however, with only two exceptions (MW-041, where n-nitrosodiphenylamine exceeds its SQO, and MW-153, where no chemical data have been obtained).

At a previous meeting, EPA requested depth and grain size information regarding subtidal stations evaluated for potential reference sites in Round 1A. After comparing these stations to waterway stations located near the mouth (MW027, MW030, MW034), EPA believes that proposed biological testing at these stations should use benthic infaunal analysis as the chronic measure. For these stations we believe a suitable subtidal reference site may exist in

MWRM202. Although lower in TOC than the waterway stations, MWRM202 is within the range of typical Puget Sound values. MWAC's assessment of rapid deposition at the waterway stations has not been supported, and EPA does not view the physical conditions as likely to impact benthic test results. If MWAC elects to conduct biological testing at MW027, MW030, and/or MW034, benthic data will need to be collected at these stations and both benthic and chemical data will be needed at MWRM202, unless sufficient chemical data are already available for the reference site. MWAC may elect to return to a previous proposal not to collect biological data at these stations, understanding that chemical SQO exceedances will then prevail.

MW037, while exceeding an SQO based on a benthic AET, does not appear to have a suitable reference site among those previously evaluated. Neanthes is therefore allowable as the chronic measure for MW037. In addition, EPA is willing to accept Neanthes at stations in the intertidal zone.

For locations where benthic analysis is already proposed (MW041 and MW153), EPA requests that MWAC identify the benthic reference stations to be used. Samples for benthic infaunal analysis will need to be collected at the reference site in Round 1B.

At Stations MW042, MW044, MW045, and MW047, further up the waterway, MWAC has proposed *Neanthes* growth tests as the chronic measure. It appears that all are within the target range of depths and grain size relative to existing intertidal reference stations in Hylebos. EPA believes that a suitable reference could be found for these stations in Hylebos waterway, and that benthic infaunal analysis would be suitable for these locations. However, EPA is willing to accept *Neanthes* tests at three of the four stations. Because MW-044 exceeds the benthic AET for mercury of 2.1 ppm, benthic infaunal analysis should be used as the chronic test.

Contamination at Depth: Wherever chemical SQO exceedances occur at depth and sediments are proposed to be left in place (due either to a lack of chemical SQO exceedances, the demonstrated absence of biological effects, or because of predicted natural recovery), the determination must be made and supported that present and future conditions and uses will not result in exposure of these sediments, and that leaving these sediments in place will not impair beneficial uses of the waterway. Some activities that may be anticipated in future include potential dredging for depth at the waterway mouth, dock construction at Simpson, piling removal at Simpson, continued boat mooring near the sides of the waterway mouth, and mitigation work associated with the potential use of St. Paul for contaminated sediment disposal.

Subsurface Data Gaps: Subsurface sediments in the waterway tideflats are not well characterized. Because the demonstration must be made that potential subsurface contamination will not be exposed in future, additional information about the subsurface is needed. Not all stations require subsurface testing, but reasonable coverage is necessary. For example, if abandoned barges are moved, what kind of materials may be resuspended or exposed? What impact could construction of dentritic channels have, if Simpson Tacoma Kraft proposals are implemented? If existing data are to be used to characterize subsurface sediments, the representativeness and quality of such data must be demonstrated. EPA requested such a

demonstration earlier this year.

Dioxins: EPA would like MWAC to collect and archive samples for dioxin analysis near potential source areas (MINI, Coast Craft, Bank 3b). Pentachlorophenol concentrations were reviewed throughout the waterway, and these locations show elevated concentrations. Pentachlorophenol, with its dioxin contaminants, degrades more quickly in the environment than dioxins. Although Pentachlorophenol was not widely found above the SQO in Middle Waterway, the elevated concentrations should be evaluated. Please add surface samples at stations MW-132 and MW-MW-135, MW-140 for archiving and potential dioxin analysis in the future. Bank station MW-146 and a surface sample somewhat offshore from MW-146 should also be collected and archived by MWAC for potential later dioxin analysis. In addition, EPA requests a sample at MW-113. Pre-cleaned containers certified as appropriate for dioxin sampling will need to be obtained from a lab. Sampling and archiving methods should be described in the SAP. EPA has not developed a dioxin cleanup level at the Olympic View Resource Area, as you are aware, but anticipates developing one based on background concentrations in Commencement Bay.

TBT: TBT may not be an issue at MW-030, MW-031, and MW-040, as they are at the low end of the range of concern identified in the SOW. However, given the TBT concentration at MW-032, it appears there are potential TBT impacts in the immediate area of the marine railway. MW-035 may be at the edge of a TBT problem area. Although Figure 15 ("Remediation Concept") does not indicate that cleanup is planned in the upper part of the marine railway, EPA believes this area will require some kind of cleanup. Figure 15 suggests that sediments under the pier and drydock may also require cleanup, and some aspects of Round 1B sampling appear intended to refine cleanup volumes in this area.

Assuming that remediation is likely to address MW-032 and shallower areas of the marine railway, EPA requires additional TBT characterization at the edges of this area, as follows: Unfiltered porewater TBT, bulk sediment TBT, and TOC should be assessed at MWAC's proposed sample locations MW-111 and MW-115, plus one new sample location shoreward of MW-111. Bulk sediment TBT sampling and analytical requirements (consistent with Harbor Island methods) should be described in an amendment to the SAP/QAPP. The unfiltered porewater will allow some comparison to Round 1A data, while the bulk TBT analyses can be compared to bulk sediment TBT at Harbor Island.

If MWAC would prefer to conduct bioaccumulation testing, such an approach would need to be described in an amendment to the SAP/QAPP.

SAP/QAPP amendment: In a meeting, EPA understood that an addendum to the SAP would be provided detailing the coring methods for natural recovery. A SAP addendum may be provided with the revised Round 1B Technical Memorandum--but it would be expeditious to provide it earlier for EPA review and approval. The SAP addendum should also address the approach to characterizing subsurface structures at the marine railway, contaminant mobility testing (tiering the testing based on chemical results from Round 1B sampling would be acceptable), dioxin

sampling requirements, and any bioaccumulation testing proposed.

Chemical groups versus individual analytes: EPA's preference in analytical tiering is to analyze for the chemical group associated with the SQO exceedance that triggers further analysis, not only the individual compound/analyte exceeding its SQO. In Table 16, for samples MW101 through MW110, although EPA accepts the analysis for mercury and copper only (rather than all metals) in surface samples, sampling of deeper intervals must provide sufficient sample volume for both analyses, and both analyses will be triggered if the surface exceeds the SQO for either mercury or copper.

Centerline as Physical Barrier: MWAC's response to EPA's comment (No. 10) does not appear valid. Stations on the opposite side of the waterway are not "completely isolated." MWAC has on occasion used data from the opposite side of the waterway to support the selection of sample locations and analytes.

PAGE-SPECIFIC COMMENTS:

Section 2.5.7 - Benthic Community

Please revise the text to reflect EPA's previously stated position regarding the suitability of Round 1A reference locations. The interpretation of the results should be revised accordingly, such that MW-049 is a "fail", rather than "not evaluated".

Section 4.1 - Area Near MW025 and Bank Segment B-13

Page 4-3 MW109 and MW110 will be analyzed "if the extent of surface mercury SQO exceedances is not defined adequately to fill Data Gap 1." As proposed on Table 16, all the samples in this area will be collected for mercury and copper, and archived samples from station MW109 will be analyzed for mercury at a minimum if sediments from station MW101 exceed the SQO for mercury, while station 110 will be analyzed for mercury if either of stations MW107 or MW108 exceed the SQO for mercury. If the SQO for copper is exceeded at these stations, analyses for copper shall be conducted in the same tiering fashion.

Section 4.2 - Area Near Marine Railway

Page 4-4 First full paragraph - The reasoning provided to support the phrase, "implying that the contamination did not originate at the marine railways" seems incomplete. Greater contamination in the subsurface than in the surface at MW030 doesn't imply a source location, but may imply a subsurface pathway or a historical source. The fact that there are cores with similar contaminants in subsurface sediments to the north (MW027), south (MW034) and across the waterway (MW031), but not in the central channel (MW029), suggests either a scour zone in the central channel or sources of similar

contaminants on opposite sides of the waterway. EPA requests an additional core between MW030 and MW034, as EPA's assumption is otherwise that the contamination is contiguous.

In a revised figure prepared by MWAC for a meeting, two additional cores were proposed between MW030 and MW027. EPA endorses further delineation of subsurface contamination in this area, but recommends that MW151 be located at the toe of the slope at the bank (this is unclear in the figure provided) and that MW152 be moved shoreward from the centerline to be at elevations comparable to MW030 and MW027. The current location may be in a scour zone. EPA understands that MW151 is intended to assess how far upslope the subsurface contamination seen at MW030 and MW027 extends. However, if MWAC intends for MW151 to assess potential subsurface contaminant transport from the east shore, EPA requests a rationale for this location.

Regarding the use of biological tests to challenge the surface SQO exceedances at stations MW27, MW30, and MW34, EPA notes that even if surface sediments show no biological SQO exceedances the subsurface contamination may trigger cleanup requirements or long-term liability, as they appear to be in an area where dredging or other construction might expose subsurface contamination left in place. The benefits of surface biological testing for these stations may be minimal in that case. Despite statements that the area, now used primarily for tug tie-ups, may be filling in and that tugs aren't eroding the area, a more comprehensive analysis would be needed to verify these statements and document that Simpson Tacoma Kraft does not have other plans for this area.

If MWAC still wants to collect biological data to challenge the SQO exceedances at core locations in the waterway mouth, biological testing may be advisable for the three additional cores (MW151, MW152, and the EPA-proposed core between MW030 and MW034). Because there is a risk that these stations will have surface SQO exceedances, a tiered approach may make sense (chemistry and acute testing first, chronic measures dependent on the results). As we have discussed, EPA has the option to not require cleanup of individual locations based on the data, practicalities, and the overall remedial plan. However, in general EPA will use chemical data for a given station in the absence of biological test results and cannot agree at this time to extrapolate biological outcomes based on nearby stations.

Regarding biological testing proposed at stations MW027, MW030, and MW034, there is a candidate reference site with comparable depth and grain size as the waterway stations above. Although TOC at station 202 is lower, it is within 20% of the low end of the range of typical Puget Sound TOC values. Based on this information, EPA requests that benthic samples be collected and analyzed as the chronic measure for stations MW027, MW030, and MW034, using station 202 as a reference site. This will require collection of benthic data at Station 202.

Note that sediments at Station MW029 contain mercury at 2.03 times the SQO. The

subsurface sediments are below SQOs. Unless MWAC considers this part of the area likely to be remediated, EPA recommends biological testing (with benthic for the chronic measure) at this station. EPA believes 206 is a suitable reference site.

TBT is briefly discussed on page 4-4. EPA has not finalized a TBT concentration of concern for porewater, but is still reviewing the significance of concentrations within the range identified in the Statement of Work. As stated above, EPA requests additional unfiltered porewater samples for TBT analysis, colocated with TOC samples and bulk TBT in surface sediments at MWAC's proposed sample locations MW-111 and MW-115, plus one new sample location shoreward of MW-111. Bulk sediment TBT sampling and analytical requirements (consistent with Harbor Island methods) should be described in an amendment to the SAP/QAPP. The unfiltered porewater will allow some comparison to Round 1A data, while the bulk TBT analyses can be compared to bulk sediment TBT at Harbor Island.

Please collect a sample for dioxin analysis at MW-111.

For the second bullet on page 4-5, please state that the "southern drydock core" referred to is MW113, as discussed.

With respect to the surface sediment samples proposed at stations MW115, MW116, and MW117, the reason for collecting surface sediments only is not clearly stated. The samples are under the pier, and are likely to have contamination above SQOs at depths greater than the top ten centimeters. EPA requests a core at 115, without tiered analyses. MWAC may wish to collect and archive cores at the other two locations for refinement of volumes. In addition, EPA requests a core approximately midway between MW035 and MW037, for analysis for metals and PAHs, plus TBT in surface porewater (as requested above). Biological testing is, of course, optional.

Page 4-6 - To gain sufficient information for a remedial action in the marine railway area, MWAC proposes advancing rods to assess penetration. EPA requests that the details of this proposal, such as spacing and depth of probing, will be provided in a SAP addendum.

Section 4.3 Area Near MW055 and Bank Segment B-10C

Page 4-6 - At this stage, MWAC has yet to complete its evaluation of the potential for recontamination. We note that Table 3 of the work plan includes water quality for only 1 sample. For this reason, while the comparison to the sediment protection levels is accurate, we cannot concur with the conclusion implied here and elsewhere that surface water which is below these concentrations is not a potentially significant source.

Page 4-6 - At Stations MW-118 - MW-125, EPA requests samples be collected for PAHs and Pesticides/PCBs analyses at all locations. Analyze for these parameters at alternating samples, say, MW119, MW121, and MW123. The other samples would be analyzed for

PAHs and Pesticides/PCBs only if the metals in those samples were below SQOs or if adjacent samples were below the metals SQOs but exceeded SQOs for PAHs or Pesticides/PCBs. Better characterization of the organics detected in the composite sample would provide necessary information for cleanup, even if cleanup may be driven by mercury results alone.

Page 4-7, first bullet - This section discusses bank samples. As we discussed, the text is unclear as to what event triggers analyses at stations MW123, MW124, and MW125, and Table 16 shows only that they are archived. EPA understands from recent discussions that these three stations will be analyzed for SQO metals, like the other five to the north, and that samples for PAH analyses will be archived and analyzed for all stations where the metals are below SQOs. EPA requests that pesticides/PCBs be archived and analyzed along with PAHs in this area, at stations where mercury is below SQOs. These changes should be reflected in the text and table. Please revise last sentence in the first bullet, as EPA does not view this as "expanding" the chemical list.

Page 4-8, first bullet - This section discusses sampling in the scow shed and vicinity. As we discussed in a meeting, if the same rationale were used for archiving samples as in the MW10C bank samples, PAH samples would be archived and analyzed only if the same sample interval doesn't exceed SQOs for metals. That rationale is acceptable for the surface station MW126. In the core at MW127, however, we don't have time to analyze archived subsurface intervals for metals first, and then for PAHs if metals are below SQOs. It makes more sense to analyze the top two intervals (R1 and R2) for both PAHs and metals, and archive both deeper intervals for analysis of PAH and/or metals in the event that the second interval (R2) exceeds SQOs for that group. EPA requests that this approach be reflected in the text and table, and that pesticides/PCBs be added to either station MW126 or MW127 for analysis in surface sediments, without archiving. Bank sample MW10C contained pesticides and PCBs above SQOs.

Please add a core west of the centerline, between stations MW-126 and MW-155. The top two intervals should be analyzed for metals, with the lower intervals archived to better assess subsurface conditions. This is because MW-040 had mercury down to 3 feet (although the top was below SQOs).

Section 4.4 Area Near Bank Segment B-9

EPA accepts the bank sampling approach proposed, but notes that sediment sample MW044 contains mercury at 4.4 times the SQO. Please note that, if the proposed biological testing at MW044 fails, active remediation may be called for, but subsurface information will be unavailable to develop volume estimates. If it passes, such subsurface information would still be necessary, unless MWAC can demonstrate to EPA's satisfaction that sufficient subsurface data exist to assess sediment volumes for potential remediation or that disturbance of the surface sediment will not occur in the future. EPA requests a core at MW044, to be analyzed for metals. EPA also requests that subsurface

samples at MW153 be collected for analysis in the event that the proposed biological testing of surface sediments fails the SQO.

Section 4.5 Area near MW050 and MW051

page 4-11 - See page 4-6 comment. As in other places, MWAC implies that there are no data gaps relative to potential sources other than bank sediments. EPA would be willing to meet to discuss the details of your proposed approach to assessing the potential for recontamination. Showing in a sketch or outline how you propose to use Round 1A and Round 1B data to support your assessment would be helpful. Until then, EPA reserves judgment as to whether there may be data gaps related to supporting assessment of recontamination potential.

Stations MW-136, MW-137, and MW-139 are surface stations--but could be cores, with the top two intervals analyzed for metals and SVOCs and the two deeper intervals archived for analysis, to be analyzed if the R2 interval exceeds SQOs. EPA has agreed to accept a core at station MW-137 only, but cautions that volume estimates for the PAH hotspot may be less precise as a result. Note that if interval R2 exceeds SQOs for a given chemical group at any of the cores in this area, both archived deeper intervals should be analyzed for that group, as the contamination at MW50 is not well bounded, and its source is unknown. Ringing this station with surface and shallow subsurface samples and preserving the option to assess deeper contamination seems advisable.

Clarify in third bullet that the surface sediment sample is MW140.

Page 4-12 - At MW135, EPA requests that the top interval (R1) be automatically submitted for PCB analyses, with two deeper intervals (R2 and R3) archived for PCB/pesticides if R1 exceeds PCB SQOs to avoid a third tier.

EPA requests that MWAC collect samples at MW132, MW135, and MW140 for dioxin analysis. The samples may be archived while EPA seeks to further assess dioxin data needs and levels of concern for sediments. Please collect samples in an 8 oz jar certified by a lab for dioxin analyses, with the same sample management requirements as for other locations, and store them in a secured freezer.

Section 4.6 Area Near Natural Resources Restoration Site

Bullet - If the goal of coring at MW141, MW142, and MW144 is to determine the vertical extent of contamination and to assess the potential for a groundwater pathway, the archiving approach seems inappropriate. EPA requests analysis of at least 3 intervals (R1, R2 and R3), with that core intervals to at least ten feet are archived for analysis in a second tier if R3 exceeds SQOs, to avoid a three-tiered analytical process. Note that, rather than limiting analysis to individual chemicals that exceed SQOs, EPA requests that MWAC conduct analyses for the analytical group associated with the SQO exceedance.

Later in the bullet, clarify that "the colocated surface samples and subsurface cores between TF-21 and TF-22" refers to MW143 (or does it?). The description or the tiering for this (or these?) cores is a little confusing. For example, what is meant by middle and bottom? What is meant by "depending on the results of the initially tested intervals in that core"? At some stations, analyses are triggered by SQO exceedance, while at others analysis is performed only if another parameter is below SQOs. For MW143, it may be unnecessary to analyze the surface, given the surface concentrations in nearby samples.

The City of Tacoma benthic results for TF-21 appear to be unusable. MWAC may want to include biological testing for MW-141 or other samples in this area.

4.7 Simpson Restoration Site

Page 4-15 - EPA notes that the Simpson restoration site monitoring report has been received by MWAC. Please revise the text to reflect the findings it presents. Note that Station 4b-SP had 2-methylphenol at 4 times the SQO. Does a data gap exist with respect to potential recontamination? This compound is not one listed as a routinely monitored chemical for the restoration site. Please discuss.

Section 4.8 Areas Near Bank Segments B-3A and B-3B

See comment on page 4-6. In the first paragraph of the section, second sentence, please clarify by adding "historical" after "No other"...Later (mid-paragraph), reference is made to "this outfall." As there are two discussed initially, please specify which outfall is being referred to.

Last sentence of final bullet - please clarify what is meant by "if the extent of SQO exceedances is not defined adequately to fill data gap 2." EPA would expect that if SQO exceedances are observed in MW-148, at a minimum archived samples from MW-147, MW-146, and MW-145 would be analyzed for PCBs (a single tiering). Moreover, the bank contamination revealed by the two composited bank samples may have affected the waterway. EPA requests that a core be collected at the toe of the bank at MW149 and the top interval (R1) be analyzed for PCBs, metals, and PAHs, with deeper intervals archived for the same parameters, because PCBs exceed both the 300 and 450 ppb criteria for CB/NT in B-3A and acenaphthene increases in concentration from the B-3A composite out to Station MW039. This station appears to be potentially affected by Simpson Tacoma Kraft proposals for dendritic channels.

A surface sample should be collected waterward of MW146 and archived for Pesticides/PCBs and dioxin analyses. If MW-148 exceeds the PCBs criterion, this station (146.1) should be analyzed, to avoid a three-tier approach. Alternatively, analyze MW-146 in for Pesticides/PCBs in the first tier and, if PCBs exceed the criterion, analyze 146.1 in the second tier.

Section 4.9 Areas Near Bank Segment B-1

As noted in comments on section 4.2, if MW027 and MW030 pass biological tests, other stations not tested will still be evaluated relative to the SQOs based on chemistry--and with known contamination at the marine railway, potential contamination at 111 and 112, and moderate contamination in the surface sediments at MW29, consider whether this arrangement provides the right value for MWAC.

At MW151 and MW152, the cores are tiered such that the surface and top core interval are analyzed (R1 and R2), while deeper intervals are only analyzed in the event of biological test failure at adjacent stations MW027 and MW030. EPA notes again that in the absence of biological effects data for MW151 and MW152, the chemical results in the surface will determine whether cleanup is needed. Please modify the last sentence of the bulleted paragraph to clarify that "in that case" means "if MW027 or MW030 show adverse biological effects".

Section 4.10 Biological Reference Areas

The first bullet notes that the appropriateness of reference locations is still problematic. EPA continues to view the reference stations as adequate for use as reference stations, based on location, elevation, grain size, and benthic community composition.

Regarding the second bullet, EPA's position continues to be that extrapolation of biological conditions from one station to chemically similar stations is not acceptable on a broad basis. Exceedance of the chemical SQO indicates a potential need for remedial action. MWAC may elect to use biological testing to override the chemical data, or may seek to develop a technically defensible prediction of natural recovery. After Round B data have been collected, MWAC may propose and justify sediment remediation areas and volumes which exclude certain areas, such as small volume/low exceedance areas surrounded by no action areas, taking into account technological and operational limitations for EPA approval.

With respect to the third and fourth bullet, EPA had requested that MWAC submit information regarding the potential suitability of reference stations evaluated in Round 1A--particularly for in-waterway stations where sediment grain size and elevation data are already in hand. EPA believes that suitable benthic reference stations do exist--but is willing to accept *Neanthes* for the chronic biological effects measure at tideflat stations, with the exception of MW-044 and the two stations presently proposed for benthic testing.

As a point of clarification, please note that Table 6 of the SOW was developed during AOC negotiations based on an assumption of synoptic chemical and biological sample collection, including samples for both benthic analyses and *Neanthes* growth tests. The

primary purpose of the tiering was to avoid unnecessary chronic testing if acute biological tests already showed effects above the SQO. Because MWAC was uncomfortable relying only on benthic testing, they could collect samples for *Neanthes* growth tests as well, and Table 6 decision criteria would apply after chemical and acute testing results had been obtained. Then, if the acute tests passed, benthic testing would not be required unless the SQO was based on a benthic AET. EPA could preserve its option to have the benthic tests analyzed. EPA did not intend for Table 6 to apply after the fact to chemical and biological results (such as at MW-049) or to be used in proposals for non-synoptic biological testing at stations where chemical data had been collected previously.

Section 4.10.1 Subtidal Areas

See above.

Section 4.10.2 Central Tideflats

See above. It would be best to list the specific Central Tideflats stations or otherwise identify the area so that "none of the tideflat stations" in the first paragraph of page 4-22 is understood.

Section 4.11 Contaminant Mobility Testing Evaluation

In the area where a potential PAH hotspot may require removal, a number of cores are being collected in Round 1B. EPA recommends that MWAC make a composite based on these cores and archive material for contaminant mobility testing, as a tiered analysis. EPA is concerned that the assumption of a Koc higher for Middle sediments than for Thea Foss sediments may not be supported above a certain TOC. In addition, it is not clear that the estimates for sediment remedial volumes consider existing biological data (such as at station MW-039). While MWAC's justification for not collecting additional contaminant mobility data may be acceptable if the assumed sediment volumes at the mouth remain high and the hotspot volume is at the low end of the assumed range, MWAC is clearly seeking to reduce the volumes at the mouth with proposed biological testing. The lack of PAH "hotspot" contaminant mobility information could lead to significant delays. It would be acceptable as an alternative approach to make a commitment in the revised technical memorandum and SAP amendment to collecting and conducting contaminant mobility tests on a representative composite sample as soon as the results of the Round 1B core sample analyses have been received from the lab. MWAC may also want to consider including tests for thin layer capping (the SBLT).

Section 5 - Assessment of the Potential for the Natural Recovery of Sediments

page 5-2 - first paragraph - "Areas where review of available historical data indicates surface chemical concentrations are improving"...Are there areas where the opposite is true? second paragraph - Given the different sample locations and sampling and

analytical methods, it may be too strong to say that data indicate improving conditions. "Suggest" would be acceptable. fourth paragraph - Note that the discussion of biological results from Station MW049 should be made consistent with EPA interpretation of Round 1A biological results.

page 5-3 - second paragraph - Note that for purposes of natural recovery, an EF for mercury of 1.29 is not "at the SQO." More solid support for natural recovery predictions will be needed.

page 5-4 - first paragraph - Editorial: Continue with the "areas where" construction, clarify "during the demonstration of natural recovery," and change East Harbor to West Harbor. The 1992 reference is to a proposed method of thin layer placement. A different method was used in implementing the West Harbor remedial design.

Section 5.2 - Round 1B Data Collection Needs to Support a Demonstration of Natural Recovery

MWAC proposes to collect very little additional data to support a natural recovery assessment, instead proposing to use data from other waterways for input parameters such as gross sedimentation rate, net sedimentation rate, and others. It is unclear how net sedimentation could be high if resuspension approaches 100% of the gross sedimentation. EPA reserves judgment as to whether the proposed input parameter values are adequate. No reference is provided for sediment porosity and density estimates for sediments at the waterway mouth.

page 5-6, Input Sediment Chemical Concentrations - The assumption is made that source sediments that would contribute to natural recovery are those at or just beyond the mouth of the Middle Waterway, based on the two layer advective flow systems reported for other waterways. The two layer flow regimes of Hylebos and Thea Foss waterways are driven by substantial freshwater sources at the heads of these waterways. The limited freshwater input to the Middle Waterway is not likely to drive the same circulation system in this waterway where tidal advection and episodic storm or anthropogenic disturbances would tend to dominate advection of resuspended sediments.

page 5-6, Non-Advective Contaminant Exchange - "Non-advective contaminant exchange" -- resuspension and offsite transport of contaminants--must be evaluated as a component of sediment dynamics. However, if it contributes significantly to the on-site reduction of chemical concentrations, such natural recovery is not an acceptable remedial alternative.

page 5-6, bioturbation rate... - How will the proposed Round 1B data collection fill this data gap?

page 5-8 - top line - Specifics on the type of corer, the field methods for sectioning, and any protocols for dry density testing (will a 3 to 5 cm interval yield sufficient material?),

and the like should be submitted in a SAP/QAPP addendum.

Section 6. Methods for Collecting Additional Data - EPA believes a SAP/QAPP addendum may be necessary, as noted in individual comments above.

Table 15. Comparison of Bioassay/Benthic Results...
As noted above, EPA requests that the interpretation of benthic data be revised in accordance with EPA's previous comment letter. This would require a change to footnotes a, b, and c. Please revise the document to reflect that the biological tests indicate a failure of the SQO at MW049. EPA interpretation in previous comments should be incorporated for Round 1A biological results.

Figure 14 - Benthic Reference Sample Location Map -
Depths at the reference locations should be indicated on this figure.

Figure 15 - Preliminary Areas Requiring Remediation
This figure should be revised to include sample locations, since this would assist in assessing which stations serve to bound the remediation areas. It should reflect potential remediation at all stations where a chemical SQO exceedance is observed and biological testing has not been conducted or did not pass the biological SQO (using EPA's interpretation).

Figure 15 indicates that much of the mouth could require remediation. If biological tests at MW-027, MW-030, MW-034, and MW-037 "pass", how will the edge of the area requiring remediation (presumably starting from the marine railway and moving towards the center of the waterway) be changed? The chemical results from MW-151, MW-152, MW-26, MW-29, MW-111, MW-112, MW-113, and MW-114 may be useful for that purpose, but the chemistry will prevail if sediments at these locations exceed SQOs, as there will be no opportunity to challenge the results with biological tests. Also, at MW-027 and MW-030, as well as at MW-037, subsurface sediments are contaminated. How will future exposure of this material be avoided?

The figure omits the vicinity of TF-23, but the bioassay results from station MW054 is insufficient to override the PCB and other exceedances at TF-23. Potential remediation areas are shown outside the scow shed, but not inside, although the station inside had an EF>3 for mercury. Also, there's an area without hatch marks next to the dry dock, which is surrounded by stations above SQOs (see MW-029, MW-035, MW-037, MW-034). Station MW025 should be included in the hatched area. What is planned for the upper portion of the marine railway? Also, if no further investigation of 4b-SP is planned, this area should be considered a potential cleanup area. Station MW-050 and Station TF-22 should be included in the hatched area. It would seem that many parts of the central tideflats areas, until biologically tested, should be shown as hatched areas.

Figure 18 - Potential Natural Recovery Areas
This is a baffling figure. The area is not defined by less than 2X the SQO in surface sediments, and biological passes at the surface don't seem to serve as "no action" areas. The basis for

bounding non-hatched area at and outside mouth is unclear. Please discuss and revise.

Suggested Modifications to Sample Locations, type of sample, analytical or other parameters:

Table 16 - This table will need to be modified to reflect the comments above. It would also be helpful if the triggers for analysis of archived samples were explicitly noted in a separate column (or at a minimum a reference to the text where the trigger is discussed were included). The footnotes should be clarified, such that archiving for "all parameters" clearly means archiving for those parameters analyzed for in the "triggering" sample, and that an SQO exceedance within a particular analytical group generally triggers analysis of the whole group, as with the triggering sample (so, if mercury and copper are tested for in the surface sediments, and one of the two exceeds the SQO, both are analyzed for in the underlying sample).

Please review the table to ensure that there are no tiering approaches that would create a third tier analysis (such as deeper intervals of cores triggered by surface results from analyses triggered in turn by SQO exceedances at adjacent stations). Rather, where deeper core intervals are being archived and the surface and near-surface intervals analyzed, an SQO exceedance in the near-surface interval (R2) should trigger analysis in both subsurface intervals.

EPA understands that the version of Table 16 submitted with the December 10, 1998 revised final Round I Technical Memorandum was intended to indicate the following:

- MW-110 will be archived for all parameters, and will be analyzed if there is an SQO exceedance at MW-107 or MW-108.
- MW-109 will be archived for all parameters, and will be analyzed if there is an SQO exceedance at MW-101, MW-105 or MW-108.
- MWCT155 was not intended to show bioassays/benthic infauna.

EPA believes the following clarifications also have been agreed to:

- analysis of MW-114 is triggered by SQO exceedances in MW-113 (in either the R1 or R2 interval).

Please note that in order to avoid a third analytical tier, all intervals at MW-113 would have to be analyzed with the second tier. As an alternative, EPA would accept the analysis of MW-113 intervals R1 and R2 in the first tier, with deeper intervals triggered by SQO exceedances in R1 or R2.

Table 16 should reflect the following additional samples:

- R1 - R4 intervals at 6 new cores (MW115, MW137, MW44, offshore of MW149, between MW30 and MW34, and between MW35 and MW37, as shown in figure), with tiered analysis of the two deeper intervals triggered by SQO exceedances in the shallower intervals.
- surface samples archived for dioxins at MW132, MW135, MW140, MW146, and MW146.1 (waterward of 146), and MW-111.

- samples for TBT in bulk sediment and unfiltered porewater, and TOC, MW-111 and MW-115, plus one new sample location shoreward of MW-111.
- Pentachlorophenol at 146.1
- Copper and Mercury in all samples near MW-025
- PAHs/PCBs (some archived, some not) in samples along bank B-10c.
- Benthic analyses at MW-044, MW027, MW030, MW034
- Any others in the above comments which are not captured by this list.

Figure 17 - EPA believes a data gap may exist between stations MW-030, MW-112, and MW-114. Please add a core here, with the top two intervals analyzed for metals, PAHs, Pesticides/PCBs. The deeper samples should be archived for tiered analysis as others are.

At stations MW-115 and MW-117, near the MINI apron pier, cores should be collected, rather than surface samples. Again, tiering of the lower two intervals is acceptable, but in a nearby station, MW-035, diethylphthalate was found to 8 feet below surface. Is there a problem with access in this area for coring?

Offshore of the MINI bulkhead, please add a core should about midway between MW-117 and MW-037. Bank sample SQO exceedances at B10-b (mercury, zinc, copper, lead, and arsenic) and B10c (mercury at 50x the SQO) make this a potential area of concern. Phthalates were found at depth at MW-025. Surface two intervals should be analyzed for metals, SVOCs, and Pesticides/PCBs to assess the influence from shipyard activities.

Attachment 6

MWAC Response to

EPA TECHNICAL REVIEW

REVISED FINAL (Second Draft)
MIDDLE WATERWAY ROUND 1B
TECHNICAL MEMORANDUM

NOTE: Some table and figure numbers in the Final Tech Memo have changed and may differ from references in EPA comments. MWAC responses have attempted to reflect these changes; nonetheless, a review of the revised list of tables and figures is recommended. Finally, please note that certain modifications were made to the Final Tech Memo at the specific direction of EPA. Such modifications should not be construed as a concurrence by MWAC, but are made to facilitate the completion of Round 1B sampling before the year 2000. Where changes are noted as being made at the direction of EPA, neither the changes nor the text of the Final Tech Memo should be construed as setting forth the views or recommendations of MWAC or its members.

GENERAL COMMENTS

EPA Comment At the SQOs- The definition of "at" the SQO is not 2X or less, but is 1X SQO. Given the analytical uncertainty, EPA may consider certain values sufficiently close to the SQO not to trigger active cleanup on a case by case basis, but anything greater than 1X SQO should be described accurately in the text.

MWAC Response *Text has been revised to reflect specific, individual SQO exceedences.*

EPA Comment: PCBs - Where PCBs exceed the SQO, biological testing will not obviate the need to address the contaminated sediments. Examples of stations where this may be an issue are MW03a, TF-23, and MW008-SP. Such areas should be included on the figure describing potential remediation areas. Also, vertical distribution of PCBs in these areas should be characterized.

MWAC Response *MWAC understands that the SQO for PCBs is based on human health and that biological testing is not appropriate. Further, areas with PCB concentrations above the SQO (MW031, TF-23, City bank samples B-14 and B-15, MW008SP, MW03A, MW10C) are not targeted for biological testing and are addressed on Figure 15 - Preliminary Remediation Concept.*

EPA Comment Synoptic Biological/Chemical Data - EPA prefers that biological tests be done synoptically with chemical analyses. Synoptic testing helps assess the potential causes for biological failures. In the MWAC response to EPA Technical Review, it is stated "MWAC proposes to perform all Round 1B chemical and biological [testing] synoptically as early in the Spring as possible." We understand that this is an error. Table 16 of the Tech Memo proposes biological tests only at stations previously sampled for chemistry.

MWAC Response *With the exception of the proposed station MW153 where chemical and biological testing will be done synoptically, all Round 1B biological-testing locations will utilize Round 1A chemistry. The text and Table 9 (formerly Table 16) will be corrected. Round 1B chemical and biological testing will be performed during a single field event.*

EPA Comment As David Templeton clarified at a meeting, the biological test sediments can be collected within ±5' of the original chemical sample locations. With this understanding, EPA will accept biological testing at previously sampled stations without further chemical analyses. Please note, however, that biological results from non-synoptic sampling stations cannot be correlated to chemical concentrations to predict biological conditions elsewhere. If MWAC does not gather biological data to override a known surface SQO exceedence, the chemical findings will prevail, unless EPA determines otherwise on a case-by-case basis.

MWAC Response *EPA's position has been incorporated into our project strategy.*

EPA Comment Biological testing/Chronic measure - As you are aware, MWAC and EPA disagree on the selection of reference stations for comparison to Round 1A test stations. EPA reaffirms its previous position with respect to interpretation of the Round 1A results. Differences in TOC are not sufficient reason to reject stations in Hylebos waterway which are otherwise comparable in terms of depth, grain size, and community structure. Moreover, suitable reference stations are available for almost all of the locations for which biological testing is proposed in Round 1B. Most of the Round 1B biological testing proposed by MWAC still relies on the *Neanthes* growth test, however, with only two exceptions (MW-041, where n-nitrosodiphenylamine exceeds its SQO, and MW-153, where no chemical data have been obtained).

MWAC Response *MWAC continues to disagree with EPA on the interpretation of the Round 1A benthic results (specifically MW049). MWAC believes that issues associated with interpretation are rooted in the difficulties in identifying appropriate reference sites. Specifically, MWAC takes exception to EPA's position that differences in TOC are not sufficient to reject a reference station and that two of the Hylebos reference stations are comparable in terms of community structure. Benthic communities are highly influenced by TOC and this is evidenced in the community structure at Hylebos stations MW205 and MW207 where several taxa show a clear response to TOC (see Table 17 of the Revised Final Round 1A Data Report). Nonetheless, MWAC will revise the Round 1A benthic results as directed by EPA.*

EPA Comment: At a previous meeting, EPA requested depth and grain size information regarding subtidal stations evaluated for potential reference sites in Round 1A. After comparing these stations to waterway stations located near the mouth (MW027, MW030, MW034), EPA believes that proposed biological testing at these stations should use benthic infaunal analysis as the chronic measure. For these stations we believe a suitable subtidal reference site may exist in MWRM202. Although lower in TOC than the waterway stations, MWRM202 is within the range of typical Puget Sound values. MWAC's assessment of rapid deposition at the waterway stations has not been supported, and EPA does not view the physical conditions as likely to impact benthic test results. If MWAC elects to conduct biological testing at MW027, MW030, and/or MW034, benthic data will need to be collected at these stations and both benthic and chemical data will be needed at MWRM202, unless sufficient chemical data are already available for the reference site. MWAC may elect to return to a previous proposal not to collect biological data at these stations, understanding that chemical SQO exceedences will then prevail.

MWAC Response *MWAC takes exception to EPA's position that differences in TOC are not sufficient to reject a reference station. Benthic communities are highly influenced by TOC (see response to above comment). Further, physical disturbance in the subtidal portion of the waterway will keep the benthic communities in a continual state of disturbance and recovery, making finding a suitable reference area virtually impossible. MWAC does not believe that benthic testing is appropriate in the subtidal area. Given EPA's direction to use the benthic test,*

MWAC will not perform biological testing at MW027 and MW030. However, MWAC continues to propose Neanthes as the chronic test at Station MW034.

EPA Comment: MW037, while exceeding an SQO based on a benthic AET, does not appear to have a suitable reference site among those previously evaluated. Neanthes is therefore allowable as the chronic measure for MW037. In addition, EPA is willing to accept Neanthes at stations in the intertidal zone.

MWAC Response *MWAC will conduct biological testing at station MW037 utilizing Neanthes as the chronic measure. In addition, as conditions (e.g., grain size, TOC) at MW034 are consistent with those at MW037, MWAC believes that Neanthes is also appropriate at this location.*

EPA Comment: For locations where benthic analysis is already proposed (MW041 and MW153), EPA requests that MWAC identify the benthic reference stations to be used. Samples for benthic infaunal analysis will need to be collected at the reference site in Round 1B.

MWAC Response *It is anticipated that Station MW206 will be used for both proposed benthic intertidal stations. Both grain size and TOC conditions at this location are appropriate for MW041, However, because no grain size or TOC information is available for Station MW153, the actual benthic reference station will be dependent on the outcome of field grain size tests and actual TOC results from this location.*

EPA Comment: At Stations MW042, MW044, MW045, and MW047, further up the waterway, MWAC has proposed *Neanthes* growth tests as the chronic measure. It appears that all are within the target range of depths and grain size relative to existing intertidal reference stations in Hylebos. EPA believes that a suitable reference could be found for these stations in Hylebos waterway, and that benthic infaunal analysis would be suitable for these locations. However, EPA is willing to accept *Neanthes* tests at three of the four stations. Because MW-044 exceeds the benthic AET for mercury of 2.1 ppm, benthic infaunal analysis should be used as the chronic test.

MWAC Response *Neanthes will be utilized as the chronic test at MW042, MW045 and MW047. Regarding MW044, it is important to note that EPA has always maintained that Neanthes is less sensitive than the benthic test, in regards to mercury. This is simply not supported by the AET database. For example, the June 1999 Draft Rule Amendments to the SMS, which include a recalculation of AETs based on the most recent science, indicate that the AET database used to calculate the ROD SQOs is out of date. Though we are not asking that the SQO of 0.59 mg/kg be changed, the SMS are proposing to raise the CSL from 0.59 mg/kg to 2.1 mg/kg. This means that for sediments below 2.1 mg/kg, unacceptable adverse effects are not expected and active remediation would not likely be required. The AET for benthic and Neanthes are almost identical (2.1 vs 2.2 mg/kg). For the record, the amphipod AET is 2.3 mg/kg and the larval test ranges from 1.7 to 2.2 mg/kg, with the exception of the 1986 Oyster AET which is 0.59 mg/kg. The point is, Neanthes is not less sensitive than the benthic test and mercury concentrations up to 2.1 – 2.3 mg/kg are not expected to have unacceptable adverse effects (this is a large part of Area B – Central Tideflats). Given that MW044 has a mercury concentration of 2.6 ppm, MWAC believes that Neanthes is the appropriate chronic test.*

EPA Comment: Contamination at Depth - Wherever chemical SQO exceedences occur at depth and sediments are proposed to be left in place (due either to a lack of chemical SQO exceedences, the

demonstrated absence of biological effects, or because of predicted natural recovery), the determination must be made and supported that present and future conditions and uses will not result in exposure of these sediments, and that leaving these sediments in place will not impair beneficial uses of the waterway. Some activities that may be anticipated in future include potential dredging for depth at the waterway mouth, dock construction at Simpson, piling removal at Simpson, continued boat mooring near the sides of the waterway mouth, and mitigation work associated with the potential use of St. Paul for contaminated sediment disposal.

MWAC Response *EPA's position has been incorporated into our project strategy.*

EPA Comment: Subsurface Data Gaps - Subsurface sediments in the waterway tideflats are not well characterized. Because the demonstration must be made that potential subsurface contamination will not be exposed in future, additional information about the subsurface is needed. Not all stations require subsurface testing, but reasonable coverage is necessary. For example, if abandoned barges are moved, what kind of materials may be resuspended or exposed? What impact could construction of dendritic channels have, if Simpson Tacoma Kraft proposals are implemented? If existing data are to be used to characterize subsurface sediments, the representativeness and quality of such data must be demonstrated. EPA requested such a demonstration earlier this year.

MWAC Response *Round 1B includes subsurface characterization of the head of the waterway area (Area C).*

In regards to subsurface conditions in the vicinity of the abandoned barges, one historical core (HC-6) was located offshore of the abandoned barges. The 0 to 1 foot interval had a mercury SQO exceedence of 1.2. Both the 1 to 2 foot and 2 to 3 foot intervals did not exhibit SQO exceedences. The representativeness and quality of these data are discussed in the EPA-approved Work Plan. No additional subsurface exploration is warranted.

In regards to the proposed habitat plan, MWAC has considered the effect of this project in the Round 1B approach, including subsurface explorations.

EPA Comment: Dioxins - EPA would like MWAC to collect and archive samples for dioxin analysis near potential source areas (MINI, Coast Craft, Bank 3b). Pentachlorophenol concentrations were reviewed throughout the waterway, and these locations show elevated concentrations. Pentachlorophenol, with its dioxin contaminants, degrades more quickly in the environment than dioxins. Although Pentachlorophenol was not widely found above the SQO in Middle Waterway, the elevated concentrations should be evaluated. Please add surface samples at stations MW-132 and MW-MW-135, MW-140 for archiving and potential dioxin analysis in the future. Bank station MW-146 and a surface sample somewhat offshore from MW-146 should also be collected and archived by MWAC for potential later dioxin analysis. In addition, EPA requests a sample at MW-113. Pre-cleaned containers certified as appropriate for dioxin sampling will need to be obtained from a lab. Sampling and archiving methods should be described in the SAP. EPA has not developed a dioxin cleanup level at the Olympic View Resource Area, as you are aware, but anticipates developing one based on background concentrations in Commencement Bay.

MWAC Response *The SAP addendum will address dioxin sampling and analysis. MWAC will collect and archive sediment for possible future dioxin analysis at MW132, MW135, MW144,*

MW146, MW157, and MW154 (offshore of MW146) if EPA and MWAC agree upon the conditions that would trigger submittal of those samples for analysis. MWAC is willing to collect the samples based on the following conditions for triggering future analysis:.

1. *EPA develops a dioxin sediment quality objective that is incorporated into the CB/NT ROD as an explanation of significant differences (ESD) and that EPA requires the analysis of all sediments in other problem areas (e.g., Thea Foss and Hylebos Waterways) which exceed pentachlorophenol concentrations of 190 ug/kg dry weight*
2. *If EPA makes a formal decision within the holding time that the St. Paul Sediment Facility Habitat Plan will not be implemented, MWAC will discuss the need for dioxin analysis of archived sediments collected from MW146 and MW154.*
3. *If Round 1B sampling and analysis results offshore of the former Coast Craft property (MW132 ,MW 135, and MW144) indicate that a remedial action is warranted in the vicinity of these archived samples, no analysis of dioxin will be performed.*

The expiration of the holding time, absent meeting the above conditions, will not trigger dioxin analysis of archived samples.

MWAC anticipates that the agreed-upon conditions will be set forth in EPA's approval of this Tech Memo.

MWAC will not collect sediment for possible future analysis of dioxin at MW113 because remediation in this area is controlled by a number of other chemicals above the SQO (see Figure 14).

EPA Comment: TBT - TBT may not be an issue at MW-030, MW-031, and MW-040, as they are at the low end of the range of concern identified in the SOW. However, given the TBT concentration at MW-032, it appears there are potential TBT impacts in the immediate area of the marine railway. MW-035 may be at the edge of a TBT problem area. Although Figure 15 ("Remediation Concept") does not indicate that cleanup is planned in the upper part of the marine railway, EPA believes this area will require some kind of cleanup. Figure 15 suggests that sediments under the pier and drydock may also require cleanup, and some aspects of Round 1B sampling appear intended to refine cleanup volumes in this area.

MWAC Response *Figure 14 (formerly Figure 15) has been revised to clarify that remediation is anticipated to be required in the upper part of the marine railway, under piers and, in the vicinity of the drydock. Round 1B activities are designed to clarify the extent of remediation and support the most appropriate alternative.*

MWAC does not believe that additional TBT testing is warranted. Middle Waterway Round 1A data had unfiltered concentrations that ranged from 0.05U to 0.401 ug/L (MW32; see Table 5 of Rd 1B Tech Memo). The West Waterway unfiltered TBT concentrations ranged from 0.01 to 1.87 ug/L and were associated with bulk concentrations of 8 to 6200 ug/kg. None of the sediments from West Waterway resulted in tissue concentrations that exceeded EPA tissue trigger value. MW32 had percent fines on the lower end of the WW range; TOC was just above the mean WW value. West Waterway bulk sediment concentrations that correspond to the Middle Waterway pore water data range from 8 to about 700 ug/kg. Based on comparison to the West Waterway data, the Middle Waterway data does not indicate an issue with TBT and does not warrant further data collection or discussion.

EPA Comment: Assuming that remediation is likely to address MW-032 and shallower areas of the marine railway, EPA requires additional TBT characterization at the edges of this area, as follows: Unfiltered porewater TBT, bulk sediment TBT, and TOC should be assessed at MWAC's proposed sample locations MW-111 and MW-115, plus one new sample location shoreward of MW-111. Bulk sediment TBT sampling and analytical requirements (consistent with Harbor Island methods) should be described in an amendment to the SAP/QAPP. The unfiltered porewater will allow some comparison to Round 1A data, while the bulk TBT analyses can be compared to bulk sediment TBT at Harbor Island.

> ***MWAC Response:*** *Based on EPA's conclusions for the West Waterway, no additional TBT testing in the Middle Waterway is warranted. Middle Waterway Round 1A data had unfiltered concentrations that ranged from 0.05U to 0.401 ug/L (MW32; see Table 2-2 of Rd 1B Tech Memo). The West Waterway unfiltered TBT concentrations ranged from 0.01 to 1.87 ug/L and were associated with bulk concentrations of 8 to 6200 ug/kg. None of the sediments from West Waterway resulted in tissue concentrations that exceeded EPA tissue trigger value. MW32 had percent fines on the lower end of the WW range; TOC was just above the mean WW value. West Waterway bulk sediment concentrations that correspond to the Middle Data pore water range from 8 to about 700 ug/kg. Based on comparison to the West Waterway data, the Middle Waterway data does not indicate an issue with TBT and does not warrant further data collection or discussion.*

EPA Comment: If MWAC would prefer to conduct bioaccumulation testing, such an approach would need to be described in an amendment to the SAP/QAPP.

> ***MWAC Response:*** *Based on Middle Waterway pore water data and synoptic pore water/bulk sediment/bioaccumulation data from the West Waterway, Middle Waterway TBT concentrations are not a concern. Consequently, MWAC does not believe that bioaccumulation testing is warranted and is not adding this information to the SAP and QAPP addendum.*

EPA Comment: SAP/QAPP Amendment - In a meeting, EPA understood that an addendum to the SAP would be provided detailing the coring methods for natural recovery. A SAP addendum may be provided with the revised Round 1B Technical Memorandum--but it would be expeditious to provide it earlier for EPA review and approval. The SAP addendum should also address the approach to characterizing subsurface structures at the marine railway, contaminant mobility testing (tiering the testing based on chemical results from Round 1B sampling would be acceptable), dioxin sampling requirements, and any bioaccumulation testing proposed.

> ***MWAC Response*** *MWAC provided EPA a SAP and QAPP Addendum on August 9, 1999. This addendum is Appendix D of the Final Round 1B Tech Memo.*

EPA Comment: Chemical groups versus individual analytes - EPA's preference in analytical tiering is to analyze for the chemical group associated with the SQO exceedance that triggers further analysis, not only the individual compound/analyte exceeding its SQO. In Table 16, for samples MW101 through MW110, although EPA accepts the analysis for mercury and copper only (rather than all metals) in surface samples, sampling of deeper intervals must provide sufficient sample volume for both analyses, and both analyses will be triggered if the surface exceeds the SQO for either mercury or copper.

MWAC Response *MWAC will revise the text to reflect the analysis of chemical groups rather than individual analytes. Table 9 (formerly Table 16) will be modified to specifically identify what analyte groups will be performed on archived intervals.*

EPA Comment Centerline as Physical Barrier - MWAC's response to EPA's comment (No. 10) does not appear valid. Stations on the opposite side of the waterway are not "completely isolated." MWAC has on occasion used data from the opposite side of the waterway to support the selection of sample locations and analytes.

MWAC Response. *MWAC recognizes that LPAHs were detected in MW024 and MW031 and that no PAH exceedences were found at MW026 and MW029. Further, PAH exceedences at MW027 and MW030 are deeper than MW026 and MW029, which implies that current depositions of sediments with SQO exceedences are not contiguous across the waterway. Therefore, even though MWAC has not made any conclusions regarding the source of PAHs, the distribution of PAHs at MW027 and MW030 warrant additional characterization (e.g., MW151 and MW152).*

SPECIFIC COMMENTS

EPA Comment: Section 2.5.7 - Benthic Community. Please revise the text to reflect EPA's previously stated position regarding the suitability of Round 1A reference locations. The interpretation of the results should be revised accordingly, such that MW-049 is a "fail", rather than "not evaluated".

MWAC Response *This section has been removed from the Final Tech Memo because it is provided in the companion Revised Final Round 1A Data Report. MWAC continues to disagree with EPA on the interpretation of the Round 1A benthic results (specifically MW049). MWAC believes that issues associated with interpretation are rooted in the difficulties in identifying appropriate reference sites. Specifically, MWAC takes exception to EPA's position that differences in TOC are not sufficient to reject a reference station and that two of the Hylebos reference stations are comparable in terms of community structure. Benthic communities are highly influenced by TOC and this is evidenced in the community structure at Hylebos stations MW205 and MW207 where several taxa show a clear response to TOC (see Table 17 of the Revised Final Round 1A Data Report). Nonetheless, MWAC will revise the Round 1A benthic results to indicate an exceedence of the No Adverse criteria at Station MW049, as directed by EPA.*

EPA Comment: Section 4.1 - Area Near MW025 and Bank Segment B-13. Page 4-3 MW109 and MW110 will be analyzed "if the extent of surface mercury SQO exceedences is not defined adequately to fill Data Gap 1." As proposed on Table 16, all the samples in this area will be collected for mercury and copper, and archived samples from station MW109 will be analyzed for mercury at a minimum if sediments from station MW101 exceed the SQO for mercury, while station 110 will be analyzed for mercury if either of stations MW107 or MW108 exceed the SQO for mercury. If the SQO for copper is exceeded at these stations, analyses for copper shall be conducted in the same tiering fashion.

MWAC Response *MWAC will revise the text to reflect this comment. Table 9 (formerly Table 16) will also be modified to specifically identify what analytes will be performed on archived intervals.*

EPA Comment: Section 4.2 - Area Near Marine Railway. Page 4-4 First full paragraph - The reasoning provided to support the phrase, "implying that the contamination did not originate at the marine railways" seems incomplete. Greater contamination in the subsurface than in the surface at MW030 doesn't imply a source location, but may imply a subsurface pathway or a historical source. The fact that there are cores with similar contaminants in subsurface sediments to the north (MW027), south (MW034) and across the waterway (MW031), but not in the central channel (MW029), suggests either a scour zone in the central channel or sources of similar contaminants on opposite sides of the waterway. EPA requests an additional core between MW030 and MW034, as EPA's assumption is otherwise that the contamination is contiguous.

> ***MWAC Response*** *MWAC recognizes that LPAHs were detected in MW024 and MW031 and that no PAH exceedences were found at MW026 and MW029. Further, PAH exceedences at MW027 and MW030 are deeper than MW026 and MW029. which implies that current depositions of sediments with SQO exceedences are not contiguous across the waterway. Therefore, even though MWAC has not made any conclusions regarding the source of PAHs, the distribution of PAHs at MW027 and MW030 warrant additional characterization (e.g., MW151 and MW152). MWAC proposes to add a core between MW030 and MW034 (MW157; full list).*

EPA Comment: In a revised figure prepared by MWAC for a meeting, two additional cores were proposed between MW030 and MW027. EPA endorses further delineation of subsurface contamination in this area, but recommends that MW151 be located at the toe of the slope at the bank (this is unclear in the figure provided) and that MW152 be moved shoreward from the centerline to be at elevations comparable to MW030 and MW027. The current location may be in a scour zone. EPA understands that MW151 is intended to assess how far upslope the subsurface contamination seen at MW030 and MW027 extends. However, if MWAC intends for MW151 to assess potential subsurface contaminant transport from the east shore, EPA requests a rationale for this location.

> ***MWAC Response*** *MW151 will be moved further offshore to the toe of the slope. MW152 will not be moved as it is positioned to delineate the outer limits of the subsurface contamination at stations MW027 and MW030.*

EPA Comment: Regarding the use of biological tests to challenge the surface SQO exceedences at stations MW27, MW30, and MW34, EPA notes that even if surface sediments show no biological SQO exceedences the subsurface contamination may trigger cleanup requirements or long-term liability, as they appear to be in an area where dredging or other construction might expose subsurface contamination left in place. The benefits of surface biological testing for these stations may be minimal in that case. Despite statements that the area, now used primarily for tug tie-ups, may be filling in and that tugs aren't eroding the area, a more comprehensive analysis would be needed to verify these statements and document that Simpson Tacoma Kraft does not have other plans for this area.

> **MWAC Response** *MWAC takes exception to EPA's position that differences in TOC are not sufficient to reject a reference station. Benthic communities are highly influenced by TOC (see response to above comment). Further, physical disturbance in the subtidal portion of the waterway will keep the benthic communities in a continual state of disturbance and recovery, making finding a suitable reference area virtually impossible. MWAC does not believe that benthic testing is appropriate in the subtidal area. Given EPA's direction to use the benthic test, MWAC will not perform biological testing at MW027 and MW030. However, MWAC continues to propose Neanthes as the chronic test at Station MW034.*

EPA Comment: If MWAC still wants to collect biological data to challenge the SQO exceedences at core locations in the waterway mouth, biological testing may be advisable for the three additional cores (MW151, MW152, and the EPA-proposed core between MW030 and MW034). Because there is a risk that these stations will have surface SQO exceedences, a tiered approach may make sense (chemistry and acute testing first, chronic measures dependent on the results). As we have discussed, EPA has the option to not require cleanup of individual locations based on the data, practicalities, and the overall remedial plan. However, in general EPA will use chemical data for a given station in the absence of biological test results and cannot agree at this time to extrapolate biological outcomes based on nearby stations.

> ***MWAC Response*** *Given EPA's direction to use the benthic test, MWAC will not perform biological testing at MW027 and MW030 or at MW151, MW152, and the EPA-proposed core between MW030 and MW034 (station MW157).*

EPA Comment: Regarding biological testing proposed at stations MW027, MW030, and MW034, there is a candidate reference site with comparable depth and grain size as the waterway stations above. Although TOC at station 202 is lower, it is within 20% of the low end of the range of typical Puget Sound TOC values. Based on this information, EPA requests that benthic samples be collected and analyzed as the chronic measure for stations MW027, MW030, and MW034, using station 202 as a reference site. This will require collection of benthic data at Station 202.

> **MWAC Response** *Given EPA's direction to use the benthic test, MWAC will not perform biological testing at MW027 and MW030. MWAC takes exception to EPA's position that differences in TOC are not sufficient to reject a reference station. Benthic communities are highly influenced by TOC (see response to above comment). In addition, as conditions (e.g., grain size, TOC) at MW034 are consistent with those at MW037 and EPA does not believe a suitable reference area is available for MW037, MWAC believes that Neanthes is appropriate at MW034.*

EPA Comment: Note that sediments at Station MW029 contain mercury at 2.03 times the SQO. The subsurface sediments are below SQOs. Unless MWAC considers this part of the area likely to be remediated, EPA recommends biological testing (with benthic for the chronic measure) at this station. EPA believes 206 is a suitable reference site.

> **MWAC Response** *EPA's position that benthic is a more appropriate chronic test even in light of technical facts, as discussed above, is unwarranted. MW029 is located directly in the middle of the working portion of the waterway and is highly influenced by scour and propwash. During Round 1A, sediment samples had to be collected at this station and station MW026 (also located in the middle of the working waterway) using a power grab because a conventional van veen could not penetrate the consolidated sediments. It is highly unlikely that a suitable benthic reference area could be located for this station. MWAC disagrees that benthic is the appropriate chronic test for MW-029. Reference location MW206 is intertidal and is clearly not appropriate. Nonetheless, Figure 14 (Preliminary Remediation Concept) has been revised to incorporate the SQO exceedence at MW029.*

EPA Comment: TBT is briefly discussed on page 4-4. EPA has not finalized a TBT concentration of concern for porewater, but is still reviewing the significance of concentrations within the range identified in the Statement of Work. As stated above, EPA requests additional unfiltered porewater samples for TBT analysis, co-located with TOC samples and bulk TBT in surface sediments at MWAC's proposed sample

locations MW-111 and MW-115, plus one new sample location shoreward of MW-111. Bulk sediment TBT sampling and analytical requirements (consistent with Harbor Island methods) should be described in an amendment to the SAP/QAPP. The unfiltered porewater will allow some comparison to Round 1A data, while the bulk TBT analyses can be compared to bulk sediment TBT at Harbor Island.

MWAC Response: *Based on EPA's conclusions for the West Waterway, no additional TBT testing in the Middle Waterway is warranted. Middle Waterway Round 1A data had unfiltered concentrations that ranged from 0.05U to 0.401 ug/L (MW32; see Table 2-2 of Rd 1B Tech Memo). The West Waterway unfiltered TBT concentrations ranged from 0.01 to 1.87 ug/L and were associated with bulk concentrations of 8 to 6200 ug/kg. None of the sediments from West Waterway resulted in tissue concentrations that exceeded EPA tissue trigger value. MW32 had percent fines on the lower end of the WW range; TOC was just above the mean WW value. West Waterway bulk sediment concentrations that correspond to the Middle Waterway pore water data range from 8 to about 700 ug/kg. Based on comparison to the West Waterway data, the Middle Waterway data does not indicate an issue with TBT and does not warrant further data collection or discussion.*

EPA Comment: Please collect a sample for dioxin analysis at MW-111.

MWAC Response: *MWAC will not collect sediment for possible future analysis of dioxin at MW113 because remediation in this area is controlled by a number of other chemicals above the SQO (see Figure 14).*

EPA Comment: For the second bullet on page 4-5, please state that the "southern drydock core" referred to is MW113, as discussed.

MWAC Response: *The text in this section has been revised.*

EPA Comment: With respect to the surface sediment samples proposed at stations MW115, MW116, and MW117, the reason for collecting surface sediments only is not clearly stated. The samples are under the pier, and are likely to have contamination above SQOs at depths greater than the top ten centimeters. EPA requests a core at 115, without tiered analyses. MWAC may wish to collect and archive cores at the other two locations for refinement of volumes. In addition, EPA requests a core approximately midway between MW035 and MW037, for analysis for metals and PAHs, plus TBT in surface porewater (as requested above). Biological testing is, of course, optional.

MWAC Response *Section 4.2, Figure 16 and Table 9 present MWAC's revised approach to the Marine Railway area. In summary, MWAC proposes that MW116 and MW155 be cores. MW117 will be a surface sample under the pier. MW115 will be a surface sample. MWAC has added a core between MW035 and MW037 (MW137); however, as discussed above, no TBT analyses is will be performed. Biological testing also is not proposed.*

EPA Comment: Page 4-6 - To gain sufficient information for a remedial action in the marine railway area, MWAC proposes advancing rods to assess penetration. EPA requests that the details of this proposal, such as spacing and depth of probing, will be provided in a SAP addendum.

MWAC Response *The specifics of the Marine Railway structure evaluation are provided in the*

SAP addendum (Appendix D).

EPA Comment: Section 4.3 Area Near MW055 and Bank Segment B-10C; Page 4-6 - At this stage, MWAC has yet to complete its evaluation of the potential for recontamination. We note that Table 3 of the work plan includes water quality for only 1 sample. For this reason, while the comparison to the sediment protection levels is accurate, we cannot concur with the conclusion implied here and elsewhere that surface water which is below these concentrations is not a potentially significant source.

MWAC Response: *Section 4.6 of the EPA-approved Work Plan identifies potential significant sources by screening sediment chemistry and existing seep and outfall data against conservative source screening levels. Further, bank samples and surface sediment samples have been collected to verify if these seep and outfall samples verify the potential (or lack of) to result in sediment concentrations above the SQO. Proposed Round 1B data will provide important information regarding the potential of on going recontamination in this area.*

Similarly, MWAC shares EPA's concern that the former Coast Craft property has been a significant source (the magnitude of the remedial action is undefined at this point) and may still be an on going source to the surface sediments. We presume that EPA and Ecology had additional information regarding this property's status as a source to Middle Waterway sediments prior to granting a pre-purchaser consent decree. If so, MWAC requests that this information be discussed during the development of the source control evaluation and any further source control activities to be conducted by Ecology.

EPA Comment: Page 4-6 - At Stations MW-118 - MW-125, EPA requests samples be collected for PAHs and Pesticides/PCBs analyses at all locations. Analyze for these parameters at alternating samples, say, MW119, MW121, and MW123. The other samples would be analyzed for PAHs and Pesticides/PCBs only if the metals in those samples were below SQOs or if adjacent samples were below the metals SQOs but exceeded SQOs for PAHs or Pesticides/PCBs. Better characterization of the organics detected in the composite sample would provide necessary information for cleanup, even if cleanup may be driven by mercury results alone.

MWAC Response: *MWAC has carefully considered EPA's proposed approach. Even though bank segment MW10c has a number of SQO exceedences, none is as prominent as mercury (49.49 times the SQO). MWAC fully expects that mercury will drive the scope of remedial actions in this area, even in the absence of organic data. Nonetheless, we believe that the revised approach presented in Section 4.3 meets EPA and MWAC's shared objectives, provides the necessary information for cleanup, considers PAH, Pesticides and PCB issues, is limited to a 2-tier approach, and is more cost effective.*

EPA Comment: Page 4-7, first bullet - This section discusses bank samples. As we discussed, the text is unclear as to what event triggers analyses at stations MW123, MW124, and MW125, and Table 16 shows only that they are archived. EPA understands from recent discussions that these three stations will be analyzed for SQO metals, like the other five to the north, and that samples for PAH analyses will be archived and analyzed for all stations where the metals are below SQOs. EPA requests that pesticides/PCBs be archived and analyzed along with PAHs in this area, at stations where mercury is below SQOs. These changes should be reflected in the text and table. Please revise last sentence in the first bullet, as EPA does not view this as "expanding" the chemical list.

MWAC Response: *Section 4.3 has been modified to reflect that sediment for pesticides and*

PCBs will be collected and archived. Also see Table 9 (formerly Table 16).

EPA Comment: Page 4-8, first bullet - This section discusses sampling in the scow shed and vicinity. As we discussed in a meeting, if the same rationale were used for archiving samples as in the MW10C bank samples, PAH samples would be archived and analyzed only if the same sample interval doesn't exceed SQOs for metals. That rationale is acceptable for the surface station MW126. In the core at MW127, however, we don't have time to analyze archived subsurface intervals for metals first, and then for PAHs if metals are below SQOs. It makes more sense to analyze the top two intervals (R1 and R2) for both PAHs and metals, and archive both deeper intervals for analysis of PAH and/or metals in the event that the second interval (R2) exceeds SQOs for that group. EPA requests that this approach be reflected in the text and table, and that pesticides/PCBs be added to either station MW126 or MW127 for analysis in surface sediments, without archiving. Bank sample MW10C contained pesticides and PCBs above SQOs.

MWAC Response: *MWAC has carefully considered EPA's proposed approach. Even though bank segment MW10c has a number of SQO exceedences, none is a prominent as mercury (49.49 times the SQO). MWAC fully expects that mercury will drive the scope of remedial actions in this area, even in the absence of organic data. Nonetheless, we believe that the revised approach presented in Section 4.3 meets EPA and MWAC's shared objectives, provides the necessary information for cleanup, considers PAH, Pesticides and PCB issues, is limited to a 2-tier approach, and is more cost effective.*

In addition, MWAC has added a core to station MW126 (inside the scow shed) and pesticides/PCBs will be analyzed in the surface sample at MW127, as EPA requests.

EPA Comment: Please add a core west of the centerline, between stations MW-126 and MW-155. The top two intervals should be analyzed for metals, with the lower intervals archived to better assess subsurface conditions. This is because MW-040 had mercury down to 3 feet (although the top was below SQOs).

MWAC Response: *MWAC has carefully considered EPA's request. Given the distribution of SQO exceedences (MW040, MW041, MW037) and the addition of cores MW158 and MW153, an additional core in this area seems excessive and does not support the design of the remedy (Figure 14). No core is added in this area.*

EPA Comment: Section 4.4 Area Near Bank Segment B-9; EPA accepts the bank sampling approach proposed, but notes that sediment sample MW044 contains mercury at 4.4 times the SQO. Please note that, if the proposed biological testing at MW044 fails, active remediation may be called for, but subsurface information will be unavailable to develop volume estimates. If it passes, such subsurface information would still be necessary, unless MWAC can demonstrate to EPA's satisfaction that sufficient subsurface data exist to assess sediment volumes for potential remediation or that disturbance of the surface sediment will not occur in the future. EPA requests a core at MW044, to be analyzed for metals. EPA also requests that subsurface samples at MW153 be collected for analysis in the event that the proposed biological testing of surface sediments fails the SQO.

MWAC Response: *MWAC is proposing biological testing at MW044. We have reviewed EPA's position for using benthic testing at MW34 and MW44; we just cannot agree with itsr rationale that TOC is not an important driving factor in determining benthic community structure or that the benthic test is more sensitive than the Neanthes test. MWAC has also considered EPA's*

position that Neanthes is less sensitive than the benthic test, in regards to mercury. This is simply not supported by the AET data base. For example, the June 1999 Draft Rule Amendments to the SMS, which include a recalculation of AETs based on the most recent science, indicate that the AET database used to calculate the ROD SQOs is out of date. Though we are not asking that the SQO of 0.59 mg/kg be changed , the SMS are proposing to raise the CSL from 0.59 mg/kg to 2.1 mg/kg. This means that for sediments below 2.1 mg/kg, unacceptable adverse effects are not expected and active remediation would not likely be required. The AET for benthic and Neanthes are almost identical (2.1 vs 2.2 mg/kg). For the record, the amphipod AET is 2.3 mg/kg and the larval test ranges from 1.7 to 2.2 mg/kg, with the exception of the 1986 Oyster AET which is 0.59 mg/kg. The point is , Neanthes is not less sensitive than the benthic test and mercury concentrations up to 2.1 – 2.3 mg/kg are not expected to have unacceptable adverse effects (this is a large part of Area B – Central Tideflats).

In the event that biological testing exhibits an adverse effect, sufficient subsurface data exists. One historical core (HC-6) was located offshore of the abandoned barges. The 0 to 1 foot interval had a mercury SQO exceedence of 1.2. Both the 1 to 2 foot and 2 to 3 foot intervals did not exhibit SQO exceedences. The representativeness and quality of these data are discussed in the EPA-approved Work Plan. Consequently, no additional subsurface exploration at MW044 is warranted. MWAC has, however, added a core to MW153.

EPA Comment: Section 4.5 Area near MW050 and MW051; page 4-11 - See page 4-6 comment. As in other places, MWAC implies that there are no data gaps relative to potential sources other than bank sediments. EPA would be willing to meet to discuss the details of your proposed approach to assessing the potential for recontamination. Showing in a sketch or outline how you propose to use Round 1A and Round 1B data to support your assessment would be helpful. Until then, EPA reserves judgment as to whether there may be data gaps related to supporting assessment of recontamination potential.

MWAC Response: *Section 4.5 of the EPA-approved Work Plan identifies potential significant sources by screening sediment chemistry and existing seep and outfall data against conservative source screening levels. Further, bank samples and surface sediment samples have been collected to verify if these seep and outfall samples verify the potential (or lack of) to result in sediment concentrations above the SQO. Proposed Round 1B data (see Section 4.5) will provide important information regarding the potential for on going recontamination in this area.*

MWAC shares EPA's concerns that the former Coast Craft property has been a significant source (the magnitude of the remedial action is undefined at this point) and may still be an on going source to the surface sediments. We presume that EPA and Ecology had additional information regarding this property's status as an source to Middle Waterway sediments prior to granting a pre-purchaser consent decree. If so, MWAC requests that this information be discussed during the development of the source control evaluation and any further source control activities to be conducted by Ecology.

EPA Comment: Stations MW-136, MW-137, and MW-139 are surface stations--but could be cores, with the top two intervals analyzed for metals and SVOCs and the two deeper intervals archived for analysis, to be analyzed if the R2 interval exceeds SQOs. EPA has agreed to accept a core at station MW-137 only, but cautions that volume estimates for the PAH hotspot may be less precise as a result. Note that if interval R2 exceeds SQOs for a given chemical group at any of the cores in this area, both archived deeper intervals should be analyzed for that group, as the contamination at MW50 is not well bounded, and its source is unknown. Ringing this station with surface and shallow subsurface samples and

preserving the option to assess deeper contamination seems advisable.

MWAC Response *Section 4.5 provides details of MWAC's proposed approach in this area. Five (5) cores are proposed (MW135, MW136, MW138, MW139, and MW141) to determine the nature and extent of sediments adjacent to the former Coast Craft site that may require remediation. Note that MWAC has added two additional cores (MW136 and MW139) in this area.*

If the results from these cores indicate that chemical concentrations increase with depth, and the possibility of a groundwater pathway exists, the installation of up to four 2-inch groundwater monitoring wells adjacent to the head of waterway will be discussed with EPA and Ecology (Figure 16).

EPA Comment: Clarify in third bullet that the surface sediment sample is MW140.

MWAC Response: *Text has been edited.*

EPA Comment: Page 4-12 - At MW135, EPA requests that the top interval (R1) be automatically submitted for PCB analyses, with two deeper intervals (R2 and R3) archived for PCB/pesticides if R1 exceeds PCB SQOs to avoid a third tier.

MWAC Response: *Section 4.5 has been revised.*

EPA Comment: EPA requests that MWAC collect samples at MW132, MW135, and MW140 for dioxin analysis. The samples may be archived while EPA seeks to further assess dioxin data needs and levels of concern for sediments. Please collect samples in an 8-oz jar certified by a lab for dioxin analyses, with the same sample management requirements as for other locations, and store them in a secured freezer.

MWAC Response: *The SAP addendum will address dioxin sampling and analysis. MWAC will collect and archive sediment for possible future dioxin analysis at MW132, MW135, MW144, MW146, MW157, and MW154 (offshore of MW146) if EPA and MWAC agree upon the conditions that would trigger submittal of those samples for analysis. MWAC is willing to collect the samples based on the following conditions for triggering future analysis:.*

1. *EPA develops a dioxin sediment quality objective that is incorporated into the CB/NT ROD as an explanation of significant differences (ESD) and that EPA requires the analysis of all sediments in other problem areas (e.g., Thea Foss and Hylebos Waterways) which exceed pentachlorophenol concentrations of 190 ug/kg dry weight*
2. *If EPA makes a formal decision within the holding time that the St. Paul Sediment Facility Habitat Plan will not be implemented, MWAC will discuss the need for dioxin analysis of archived sediments collected from MW146 and MW154.*
3. *If Round 1B sampling and analysis results offshore of the former Coast Craft property (MW132 ,MW 135, and MW144) indicate that a remedial action is warranted in the vicinity of these archived samples, no analysis of dioxin will be performed.*

The expiration of the holding time, absent meeting the above conditions, will not trigger dioxin analysis of archived samples.

EPA Comment: Section 4.6 Area Near Natural Resources Restoration Site; Bullet - If the goal of coring at MW141, MW142, and MW144 is to determine the vertical extent of contamination and to assess the potential for a groundwater pathway, the archiving approach seems inappropriate. EPA requests analysis of at least 3 intervals (R1, R2 and R3), with that core intervals to at least ten feet are archived for analysis in a second tier if R3 exceeds SQOs, to avoid a three-tiered analytical process. Note that, rather than limiting analysis to individual chemicals that exceed SQOs, EPA requests that MWAC conduct analyses for the analytical group associated with the SQO exceedence.

MWAC Response: *The text and Table 9 (formerly Table 16) have been modified.*

EPA Comment: Later in the bullet, clarify that "the collocated surface samples and subsurface cores between TF-21 and TF-22" refers to MW143 (or does it?). The description or the tiering for this (or these?) cores is a little confusing. For example, what is meant by middle and bottom? What is meant by "depending on the results of the initially tested intervals in that core"? At some stations, analyses are triggered by SQO exceedence, while at others analysis is performed only if another parameter is below SQOs. For MW143, it may be unnecessary to analyze the surface, given the surface concentrations in nearby samples.

MWAC Response: *Section 4.6 and Table 9 (formerly Table 16) have been modified to clarify the sampling approach.*

EPA Comment: The City of Tacoma benthic results for TF-21 appear to be unusable. MWAC may want to include biological testing for MW-141 or other samples in this area.

MWAC Response: *No biological testing is proposed in this area. Based on MWAC's review of the City's Draft Restoration and CAP, EPA may want to discuss how the results of Round 1A/1B may affect the City's proposed project and the need for the City it may be practical to address impacted sediments outside the project boundary, as currently defined, during restoration activities.*

EPA Comment: 4.7 Simpson Restoration Site; Page 4-15 - EPA notes that the Simpson restoration site monitoring report has been received by MWAC. Please revise the text to reflect the findings it presents. Note that Station 4b-SP had 2-methylphenol at 4 times the SQO. Does a data gap exist with respect to potential recontamination? This compound is not one listed as a routinely monitored chemical for the restoration site. Please discuss.

MWAC Response: *The most recent surface sediment monitoring data for the Simpson Restoration site have been incorporated into the Final Data Report. These surface sediment data exhibited no exceedences of the SQO. The SQO exceedences 4b-SP of benzoic acid (1.52), benzyl alcohol (1.16), 2-methylphenol (4.13), and mercury (1.15) detected during Round 1A appear to very isolated and will be addressed by the St. Paul Sediment Facility Habitat Plan, if implemented. If the habitat plan is not implemented, the potential for an on going source at this location will be discussed with Simpson Tacoma Kraft and reflected in our source control evaluation and remediation plan.*

EPA Comment: Section 4.8 Areas Near Bank Segments B-3A and B-3B; See comment on page 4-6. In the first paragraph of the section, second sentence, please clarify by adding "historical" after "No

other"...Later (mid-paragraph), reference is made to "this outfall." As there are two discussed initially, please specify which outfall is being referred to.

MWAC Response: *Text has been modified.*

EPA Comment: Last sentence of final bullet - please clarify what is meant by "if the extent of SQO exceedences is not defined adequately to fill data gap 2." EPA would expect that if SQO exceedences are observed in MW-148, at a minimum archived samples from MW-147, MW-146, and MW-145 would be analyzed for PCBs (a single tiering). Moreover, the bank contamination revealed by the two composited bank samples may have affected the waterway. EPA requests that a core be collected at the toe of the bank at MW149 and the top interval (R1) be analyzed for PCBs, metals, and PAHs, with deeper intervals archived for the same parameters, because PCBs exceed both the 300 and 450 ppb criteria for CB/NT in B-3A and acenaphthene increases in concentration from the B-3A composite out to Station MW039. This station appears to be potentially affected by Simpson Tacoma Kraft proposals for dendritic channels.

MWAC Response: *Text has been modified to clarify sampling/analytical approach. MWAC has added a core and co-located surface sample (MW156) off of MW150 in the area potentially affected by dendritic channels.*

EPA Comment: A surface sample should be collected waterward of MW146 and archived for Pesticides/PCBs and dioxin analyses. If MW-148 exceeds the PCBs criterion, this station (146.1) should be analyzed, to avoid a three-tier approach. Alternatively, analyze MW-146 in for Pesticides/PCBs in the first tier and, if PCBs exceed the criterion, analyze 146.1 in the second tier.

MWAC Response: *A surface sample (MW154) has been added waterward of MW146 and text modified to reflect the archiving approach. See response to general comments on dioxin sampling.*

EPA Comment: Section 4.9 Areas Near Bank Segment B-1; As noted in comments on section 4.2, if MW027 and MW030 pass biological tests, other stations not tested will still be evaluated relative to the SQOs based on chemistry--and with known contamination at the marine railway, potential contamination at 111 and 112, and moderate contamination in the surface sediments at MW29, consider whether this arrangement provides the right value for MWAC.

MWAC Response: *First, MWAC recognizes that LPAHs were detected in MW024 and MW031 and that no PAH exceedences were found at MW026 and MW029. Further, PAH exceedences at MW027 and MW030 are deeper than MW026 and MW029. which implies that current depositions of sediments with SQO exceedences are not contiguous across the waterway. Therefore, even though MWAC has not made any conclusions regarding the source of PAHs, the distribution of PAHs at MW027 and MW030 warrant additional characterization (e.g., MW151, MW152, MW111, MW112). Second, MWAC is not proposing to do biological testing at MW027 and MW030 as a direct result of EPA's insistence on the use of the benthic test. Third, MWAC's preliminary remediation concept (Figure 14) addresses these areas.*

EPA Comment: At MW151 and MW152, the cores are tiered such that the surface and top core interval are analyzed (R1 and R2), while deeper intervals are only analyzed in the event of biological test failure at adjacent stations MW027 and MW030. EPA notes again that in the absence of biological effect data

for MW151 and MW152, the chemical results in the surface will determine whether cleanup is needed. Please modify the last sentence of the bulleted paragraph to clarify that "in that case" means "if MW027 or MW030 show adverse biological effects".

MWAC Response: *No surface samples will be collected at MW151 or MW152 and no biological testing will be performed.*

EPA Comment: Section 4.10 Biological Reference Areas. The first bullet notes that the appropriateness of reference locations is still problematic. EPA continues to view the reference stations as adequate for use as reference stations, based on location, elevation, grain size, and benthic community composition.

MWAC Response: *MWAC continues to disagree with the adequacy of the benthic reference areas (see response to General Comments).*

EPA Comment: Regarding the second bullet, EPA's position continues to be that extrapolation of biological conditions from one station to chemically similar stations is not acceptable on a broad basis. Exceedence of the chemical SQO indicates a potential need for remedial action. MWAC may elect to use biological testing to override the chemical data, or may seek to develop a technically defensible prediction of natural recovery. After Round B data have been collected, MWAC may propose and justify sediment remediation areas and volumes which exclude certain areas, such as small volume/low exceedence areas surrounded by no action areas, taking into account technological and operational limitations for EPA approval.

MWAC Response: *MWAC does not anticipate extrapolating biological test results from one or more stations to chemically similar stations on a broad basis, but may do so where there is a high density of biological testing locations and predominance of one chemical. MWAC may also propose and justify sediment remediation areas and volumes which exclude certain areas, such as small volume/low exceedence areas surrounded by no action areas, taking into account technological and operational limitations for EPA approval.*

EPA Comment: With respect to the third and fourth bullet, EPA had requested that MWAC submit information regarding the potential suitability of reference stations evaluated in Round 1A--particularly for in-waterway stations where sediment grain size and elevation data are already in hand. EPA believes that suitable benthic reference stations do exist--but is willing to accept *Neanthes* for the chronic biological effects measure at tideflat stations, with the exception of MW-044 and the two stations presently proposed for benthic testing.

MWAC Response: *Neanthes will be utilized as the chronic test at MW042, MW045 and MW047. MWAC is proposing biological testing at MW044. We have reviewed EPA's position for using benthic testing at MW34 and MW44; we just cannot agree with their rationale that TOC is not an important driving factor in determining benthic community structure or that the benthic test is more sensitive than the Neanthes test. MWAC has also considered EPA's position that Neanthes is less sensitive than the benthic test, in regards to mercury. This is simply not supported by the AET database. For example, the June 1999 Draft Rule Amendments to the SMS, which include a recalculation of AETs based on the most recent science, indicate that the AET database used to calculate the ROD SQOs is out of date. Though we are not asking that the SQO of 0.59 mg/kg be changed, the SMS are proposing to raise the CSL from 0.59 mg/kg to 2.1 mg/kg. This means that for sediments below 2.1 mg/kg, unacceptable adverse effects are not expected and active remediation would not likely be required. The AET for benthic and*

Neanthes are almost identical (2.1 vs 2.2 mg/kg). For the record, the amphipod AET is 2.3 mg/kg and the larval test ranges from 1.7 to 2.2 mg/kg, with the exception of the 1986 Oyster AET which is 0.59 mg/kg. The point is , Neanthes is not less sensitive than the benthic test and mercury concentrations up to 2.1 – 2.3 mg/kg are not expected to have unacceptable adverse effects (this is a large part of Area B – Central Tideflats. Given that MW044 has a mercury concentration of 2.6 ppm, MWAC believes that the Neanthes is the appropriate chronic test.

EPA Comment: As a point of clarification, please note that Table 6 of the SOW was developed during AOC negotiations based on an assumption of synoptic chemical and biological sample collection, including samples for both benthic analyses and *Neanthes* growth tests. The primary purpose of the tiering was to avoid unnecessary chronic testing if acute biological tests already showed effects above the SQO. Because MWAC was uncomfortable relying only on benthic testing, they could collect samples for *Neanthes* growth tests as well, and Table 6 decision criteria would apply after chemical and acute testing results had been obtained. Then, if the acute tests passed, benthic testing would not be required unless the SQO was based on a benthic AET. EPA could preserve its option to have the benthic tests analyzed. EPA did not intend for Table 6 to apply after the fact to chemical and biological results (such as at MW-049) or to be used in proposals for non-synoptic biological testing at stations where chemical data had been collected previously.

MWAC Response: *EPA's position has been taken into account in revising the Tech Memo.*

EPA Comment: Section 4.10.1 Subtidal Areas. See above.

MWAC Response *MWAC takes exception to EPA's position that differences in TOC are not sufficient to reject a reference station. Benthic communities are highly influenced by TOC (see response to above comment). Further, physical disturbance in the subtidal portion of the waterway will keep the benthic communities in a continual state of disturbance and recovery, making finding a suitable reference area virtually impossible. MWAC does not believe that benthic testing is appropriate in the subtidal area. Given EPA's direction to use the benthic test, MWAC will not perform biological testing at MW027 and MW030. However, MWAC continues to propose Neanthes as the chronic test at Station MW034.*

EPA Comment: Section 4.10.2 Central Tideflats. See above. It would be best to list the specific Central Tideflats stations or otherwise identify the area so that "none of the tideflat stations" in the first paragraph of page 4-22 is understood.

MWAC Response: *Text has been modified to include all stations between MW039 and MW049 and has identified the Central Tideflats as "Area B".*

EPA Comment: Section 4.11 Contaminant Mobility Testing Evaluation. In the area where a potential PAH hotspot may require removal, a number of cores are being collected in Round 1B. EPA recommends that MWAC make a composite based on these cores and archive material for contaminant mobility testing, as a tiered analysis. EPA is concerned that the assumption of a Koc higher for Middle sediments than for Thea Foss sediments may not be supported above a certain TOC. In addition, it is not clear that the estimates for sediment remedial volumes consider existing biological data (such as at station MW-039). While MWAC's justification for not collecting additional contaminant mobility data may be acceptable if the assumed sediment volumes at the mouth remain high and the hotspot volume is at

the low end of the assumed range, MWAC is clearly seeking to reduce the volumes at the mouth with proposed biological testing. The lack of PAH "hotspot" contaminant mobility information could lead to significant delays. It would be acceptable as an alternative approach to make a commitment in the revised technical memorandum and SAP amendment to collecting and conducting contaminant mobility tests on a representative composite sample as soon as the results of the Round 1B core sample analyses have been received from the lab. MWAC may also want to consider including tests for thin layer capping (the SBLT).

MWAC Response: *As presented in Table 10, the inclusion of potential "hotspot" sediments to the sediments requiring removal, with consideration of combined disposal with other CB/NT sediments, the predictive accuracy of the contaminant mobility test results is not affected. If, however, Round 1B investigations in the head (Area C) indicate that the concentration and the volume of sediments that require active remediation is greater than anticipated (not appropriate for nearshore or aquatic disposal), alternatives to removal and disposal with sediments from the working waterway area (Area A) will be evaluated. To support these evaluations, duplicate cores at MW135, MW136, MW138, MW139, MW141, MW142, MW143, and MW144 will be collected anoxically and archived at 4° C for up to one year. If Round 1B data from Area C indicates that dredging and upland disposal or in-place capping is a remedial action, archived cores will be extracted in an anoxic environment to create, in consultation with EPA, a composite representative of potential remedial action areas. This composite sediment may be submitted for Sequential Batch Leaching Test (SBLT) and/or tests required for Subtitle D disposal. Finally, MWAC has decided not to conduct biological testing as a direct result of EPA's insistence on the use of benthic testing as the chronic measure. Therefore, MWAC is not "clearly seeking to reduce the [previously estimated] volumes at the mouth with proposed biological testing" MWAC's rationale, therefore, remains reasonable and justifiable.*

EPA Comment: Section 5 - Assessment of the Potential for the Natural Recovery of Sediments; page 5-2 - first paragraph - "Areas where review of available historical data indicates surface chemical concentrations are improving"...Are there areas where the opposite is true? second paragraph - Given the different sample locations and sampling and analytical methods, it may be too strong to say that data indicate improving conditions. "Suggest" would be acceptable. fourth paragraph - Note that the discussion of biological results from Station MW049 should be made consistent with EPA interpretation of Round 1A biological results.

MWAC Response: *These edits have been made.*

EPA Comment: page 5-3 - second paragraph - Note that for purposes of natural recovery, an EF for mercury of 1.29 is not "at the SQO." More solid support for natural recovery predictions will be needed.

MWAC Response: *Elements of the natural recovery demonstration are presented in Section 5.*

EPA Comment: page 5-4 - first paragraph - Editorial: Continue with the "areas where" construction, clarify "during the demonstration of natural recovery," and change East Harbor to West Harbor. The 1992 reference is to a proposed method of thin layer placement. A different method was used in implementing the West Harbor remedial design.

MWAC Response: *This edit has been made.*

EPA Comment: Section 5.2 - Round 1B Data Collection Needs to Support a Demonstration of Natural Recovery. MWAC proposes to collect very little additional data to support a natural recovery assessment, instead proposing to use data from other waterways for input parameters such as gross sedimentation rate, net sedimentation rate, and others. It is unclear how net sedimentation could be high if resuspension approaches 100% of the gross sedimentation. EPA reserves judgment as to whether the proposed input parameter values are adequate. No reference is provided for sediment porosity and density estimates for sediments at the waterway mouth.

> ***MWAC Response:*** *Round 1B data collection needs necessary to support a demonstration of natural recovery are provided in Section 5. The text has been corrected to state that "net deposition will approach 100 percent of the gross sedimentation rate" (little re-suspension). For the modeling element of a natural recovery demonstration, MWAC will use a range of CB values to predict the range of rates. The modeling element would be considered in conjunction with other elements discussed in Section 5.1.*

EPA Comment: page 5-6, Input Sediment Chemical Concentrations - The assumption is made that source sediments that would contribute to natural recovery are those at or just beyond the mouth of the Middle Waterway, based on the two layer advective flow systems reported for other waterways. The two layer flow regimes of Hylebos and Thea Foss waterways are driven by substantial freshwater sources at the heads of these waterways. The limited freshwater input to the Middle Waterway is not likely to drive the same circulation system in this waterway where tidal advection and episodic storm or anthropogenic disturbances would tend to dominate advection of resuspended sediments.

> ***MWAC Response:*** *The text has been modified to acknowledge that the transport of sediment from Area A will be largely through tidal advection, episodic storm, or propeller wash. If a channel is proposed from the Puyallap River, the transport of sediment would need to be addressed prior to construction and considered in the natural recovery demonstration.*

EPA Comment: page 5-6, Non-Advective Contaminant Exchange - "Non-advective contaminant exchange" -- resuspension and offsite transport of contaminants--must be evaluated as a component of sediment dynamics. However, if it contributes significantly to the on-site reduction of chemical concentrations, such natural recovery is not an acceptable remedial alternative.

> ***MWAC Response:*** *If non-advective processes result in significant off-site transport of sediments, natural recovery may not be an acceptable remedial alternative. The modeling element for natural recovery will include a sensitivity analysis to determine the relevant importance of this parameter.*

EPA Comment: page 5-6, bioturbation rate... - How will the proposed Round 1B data collection fill this data gap?

> ***MWAC Response:*** *The approach is discussed in more detail in Section 5.2. The mercury profile will be evaluated against historical profiles to estimate the bioturbation rate. This method has been employed in the Hylebos and Sitcum waterways.*

EPA Comment: page 5-8 - top line - Specifics on the type of corer, the field methods for sectioning, and any protocols for dry density testing (will a 3 to 5 cm interval yield sufficient material?), and the like

should be submitted in a SAP/QAPP addendum.

MWAC Response: *The information is included in Appendix D.*

EPA Comment: Section 6. Methods for Collecting Additional Data - EPA believes a SAP/QAPP addendum may be necessary, as noted in individual comments above.

MWAC Response: *MWAC provided EPA with a SAP and QAPP Addendum on August 9, 1999. This addendum is Appendix D of the Final Round 1B Tech Memo.*

EPA Comment: Table 15. Comparison of Bioassay/Benthic Results... As noted above, EPA requests that the interpretation of benthic data be revised in accordance with EPA's previous comment letter. This would require a change to footnotes a, b, and c. Please revise the document to reflect that the biological tests indicate a failure of the SQO at MW049. EPA interpretation in previous comments should be incorporated for Round 1A biological results.

MWAC Response: *This table and section has been removed from the Final Tech Memo because it is provided in the companion Revised Final Round 1A Data Report. MWAC continues to disagree with EPA on the interpretation of the Round 1A benthic results (specifically MW049). MWAC believes that issues associated with interpretation are rooted in the difficulties in identifying appropriate reference sites. Specifically, MWAC takes exception to EPA's position that differences in TOC are not sufficient to reject a reference station and that two of the Hylebos reference stations are comparable in terms of community structure. Benthic communities are highly influenced by TOC and this is evidenced in the community structure at Hylebos stations MW205 and MW207 where several taxa show a clear response to TOC (see Table 17 of the Revised Final Round 1A Data Report). Nonetheless, MWAC will revise the Round 1A benthic results to indicate an exceedence of the No Adverse criteria at Station MW049, as directed by EPA.*

EPA Comment: Figure 14 - Benthic Reference Sample Location Map Depths at the reference locations should be indicated on this figure.

MWAC Response: *This figure has been removed from the Final Tech Memo. The Final Data Report figure has bathymetric contour lines.*

EPA Comment: Figure 15 - Preliminary Areas Requiring Remediation This figure should be revised to include sample locations, since this would assist in assessing which stations serve to bound the remediation areas. It should reflect potential remediation at all stations where a chemical SQO exceedence is observed and biological testing has not been conducted or did not pass the biological SQO (using EPA's interpretation).

MWAC Response: *Figure 14 (formerly Figure 15) has been revised.*

EPA Comment: Figure 15 indicates that much of the mouth could require remediation. If biological tests at MW-027, MW-030, MW-034, and MW-037 "pass", how will the edge of the area requiring remediation (presumably starting from the marine railway and moving towards the center of the waterway) be changed? The chemical results from MW-151, MW-152, MW-26, MW-29, MW-111, MW-112, MW-113, and MW-114 may be useful for that purpose, but the chemistry will prevail if sediments at

these locations exceed SQOs, as there will be no opportunity to challenge the results with biological tests. Also, at MW-027 and MW-030, as well as at MW-037, subsurface sediments are contaminated. How will future exposure of this material be avoided?

MWAC Response: *Biological testing will not be conducted at MW027 or MW030. Figure 14 (formerly Figure 15) has been revised.*

EPA Comment: The figure omits the vicinity of TF-23, but the bioassay results from station MW054 is insufficient to override the PCB and other exceedences at TF-23. Potential remediation areas are shown outside the scow shed, but not inside, although the station inside had an EF>3 for mercury. Also, there's an area without hatch marks next to the dry dock, which is surrounded by stations above SQOs (see MW-029, MW-035, MW-037, MW-034). Station MW025 should be included in the hatched area. What is planned for the upper portion of the marine railway? Also, if no further investigation of 4b-SP is planned, this area should be considered a potential cleanup area. Station MW-050 and Station TF-22 should be included in the hatched area. It would seem that many parts of the central tideflats areas, until biologically tested, should be shown as hatched areas.

MWAC Response: *. Figure 14 (formerly Figure 15) has been revised.*

EPA Comment: Figure 18 - Potential Natural Recovery Areas This is a baffling figure. The area is not defined by less than 2X the SQO in surface sediments, and biological passes at the surface don't seem to serve as "no action" areas. The basis for bounding non-hatched area at and outside mouth is unclear. Please discuss and revise.

MWAC Response: *. Figure 17 (formerly Figure 18) has been revised and the elements considered in developing this figure are discussed in Section 5.*

Suggested Modifications to Sample Locations, type of sample, analytical or other parameters:

EPA Comment: Table 16 - This table will need to be modified to reflect the comments above. It would also be helpful if the triggers for analysis of archived samples were explicitly noted in a separate column (or at a minimum a reference to the text where the trigger is discussed were included). The footnotes should be clarified, such that archiving for "all parameters" clearly means archiving for those parameters analyzed for in the "triggering" sample, and that an SQO exceedence within a particular analytical group generally triggers analysis of the whole group, as with the triggering sample (so, if mercury and copper are tested for in the surface sediments, and one of the two exceeds the SQO, both are analyzed for in the underlying sample).

MWAC Response: *Table 9 (formerly Table 16) has been revised. Subject to MWAC's response to comments on the biological testing, TBT analysis, and the collection and archiving of dioxin samples.*

EPA Comment: Please review the table to ensure that there are no tiering approaches that would create a third tier analysis (such as deeper intervals of cores triggered by surface results from analyses triggered in turn by SQO exceedences at adjacent stations). Rather, where deeper core intervals are being archived and the surface and near-surface intervals analyzed, an SQO exceedence in the near-surface interval (R2) should trigger analysis in both subsurface intervals.

MWAC Response: *Table 9 (formerly Table 16) has been revised.*

EPA Comment: EPA understands that the version of Table 16 submitted with the December 10, 1998 revised final Round I Technical Memorandum was intended to indicate the following:

- MW-110 will be archived for all parameters, and will be analyzed if there is an SQO exceedence at MW-107 or MW-108.
- MW-109 will be archived for all parameters, and will be analyzed if there is an SQO exceedence at MW-101, MW-105 or MW-108.
- MWCT155 was not intended to show bioassays/benthic infauna.

MWAC Response: *Table 9 (formerly Table 16) has been revised.*

EPA Comment: EPA believes the following clarifications also have been agreed to:

- analysis of MW-114 is triggered by SQO exceedences in MW-113 (in either the R1 or R2 interval).

MWAC Response: *No surface sample will be collected at MW113, however, analysis at MW114 will be conducted on the upper interval and archived intervals will be triggered by SQO exceedences in the R2 interval of MW114.*

EPA Comment: Please note that in order to avoid a third analytical tier, all intervals at MW-113 would have to be analyzed with the second tier. As an alternative, EPA would accept the analysis of MW-113 intervals R1 and R2 in the first tier, with deeper intervals triggered by SQO exceedences in R1 or R2.

MWAC Response: *The text and Table 9 have been modified to avoid a third tier.*

EPA Comment: Table 16 should reflect the following additional samples:

- R1 - R4 intervals at 6 new cores (MW115, MW137, MW44, offshore of MW149, between MW30 and MW34, and between MW35 and MW37, as shown in figure), with tiered analysis of the two deeper intervals triggered by SQO exceedences in the shallower intervals.
- surface samples archived for dioxins at MW132, MW135, MW140, MW146, and MW146.1 (waterward of 146), and MW-111.
- samples for TBT in bulk sediment and unfiltered porewater, and TOC, MW-111 and MW-115, plus one new sample location shoreward of MW-111.
- Pentachlorophenol at 146.1
- Copper and Mercury in all samples near MW-025
- PAHs/PCBs (some archived, some not) in samples along bank B-10c.
- Benthic analyses at MW-044, MW027, MW030, MW034
- Any others in the above comments which are not captured by this list.

MWAC Response: *Table 9 (formerly Table 16) and the text have been revised.*

EPA Comment: Figure 17 - EPA believes a data gap may exist between stations MW-030, MW-112, and MW-114. Please add a core here, with the top two intervals analyzed for metals, PAHs, Pesticides/PCBs. The deeper samples should be archived for tiered analysis as others are.

MWAC Response: *A core (MW157) has been added at this location. No surface sample will be collected, but the upper interval (R2) will be analyzed in the first tier.*

EPA Comment: At stations MW-115 and MW-117, near the MINI apron pier, cores should be collected, rather than surface samples. Again, tiering of the lower two intervals is acceptable, but in a nearby station, MW-035, diethylphthalate was found to 8 feet below surface. Is there a problem with access in this area for coring?

MWAC Response: *A core will be collected at MW116. Station MW115 and MW117 will remain surface samples.*

EPA Comment: Offshore of the MINI bulkhead, please add a core should about midway between MW-117 and MW-037. Bank sample SQO exceedences at B10-b (mercury, zinc, copper, lead, and arsenic) and B10c (mercury at 50x the SQO) make this a potential area of concern. Phthalates were found at depth at MW-025. Surface two intervals should be analyzed for metals, SVOCs, and Pesticides/PCBs to assess the influence from shipyard activities.

MWAC Response: *A core and co-located surface sample (MW137) has been added at this location.*

Attachment 7

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

September 10, 1999

SENT BY CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Kim Maree Johannessen
Johannessen & Associates, P.S.
5413 Meridian Avenue North, Suite C
Seattle, WA 98103-6138

-and-

David Templeton
Anchor Environmental
1411 4th Avenue, Suite 1210
Seattle, WA 98101

Re: EPA comments on Final Round 1B Technical Memorandum (dated August 23, 1999), Revised Final Round 1A Data Report (August 23, 1999), and SAP/QAPP Addendum (August 9, 1999).

After reviewing the above documents, EPA is providing comments by this letter and following enclosures. Other reviewers included EPA technical consultants at Roy F. Weston, Inc.

EPA recognizes that MWAC has made much progress towards addressing EPA's recommendations in the Final Round 1B Technical Memorandum. EPA also has made a concerted effort to move this process forward. In this review, EPA accepted several recommendations submitted by MWAC; for example, EPA will not require additional TBT characterization at this time though it was previously requested. However, though many issues have been resolved, EPA has identified existing concerns not fully addressed as requested by former site manager Ellen Hale in her previous correspondence (dated July 7, 1999). Therefore, this letter serves to reiterate specific EPA comments that, once addressed, will enable MWAC to proceed with the final phase of pre-remedial design sampling.

EPA anticipates that MWAC will make the required changes to sample locations, type of sample, proposed analytes, and analytical tiering to ensure that work to support combined disposal will be completed in time. EPA expects to receive all requested revisions (particularly to

Table 9 and Figure 16) and replacement pages within forty-five (45) days of MWAC receipt of this letter. If MWAC intends to begin field work next week, please submit by COB Monday, September 13, 1999, MWAC's written commitment that all EPA recommendations will be fully addressed. In addition, EPA's enclosed comments will require MWAC to submit a SAP/QAPP Addendum regarding analytical methods and QA/QC procedures for requested dioxin analysis within fifteen (15) days of MWAC receipt of this letter.

With the above stated conditions, EPA approves MWAC's Final Round 1B Technical Memorandum and SAP/QAPP Addendum with the enclosed modifications as required by EPA. Please note that this does not include approval of the natural recovery sections of the Final Round 1B Technical Memorandum and SAP/QAPP Addendum. EPA is still reviewing these sections (e.g., sediment stakes) and will provide comments early next week. Please also note that EPA's approval should not be interpreted as approval of the proposed remediation concept included in the report.

In addition to the Final Round 1B Technical Memorandum, EPA reviewed the Revised Final Round 1A Data Report submitted by MWAC on August 23, 1999. As indicated in the enclosed comments, EPA has identified some editorial revisions and previously requested information that MWAC has yet to provide. Please note that EPA expects MWAC to submit the editorial revisions and previously requested information within thirty (30) days of MWAC receipt of this letter.

Finally, in the near future, EPA would like to meet with MWAC to discuss several issues related to source control assessment, recontamination analysis, habitat mitigation plan, and natural recovery. EPA will be in touch with you to further discuss the proposed meeting topics. Please contact Ted Yackulic at (206) 553-1218 or have David Templeton contact me at (206) 553-6511 if you have any questions regarding this letter. I look forward to meeting with you soon.

Sincerely,

Angela Chung

Angela Chung
Site Manager

Enclosures

cc: Elly Hale (EPA)
Ted Yackulic (EPA)
Alison Reak (RF Weston)
Steve Hoffman (URSG)
Russ McMillan (Ecology)
Helen Hillman (NOAA-EPA)
Bob Taylor (NOAA-Sand Point)

EPA Comments on Final Round 1B Technical Memorandum (dated August 23, 1999)

General Notes (Requiring no changes):

- For this review, EPA's comments reprinted in the MWAC Response to EPA Technical Review (RTR) were numbered sequentially and are referred to below (e.g., P. 1, EPA #2). In addition, references to the Round 1B Technical Memorandum are also indicated below by section and page number (e.g., Section 4-4, p.4.9.).

- In its review, EPA assumes that MWAC will include mercury as one of the metals analyzed for the stations where metals analysis is specified.

EPA Comments Requiring Revisions to Text, Tables, and/or Figures

As stated previously, this section includes a reiteration of EPA comments submitted to MWAC by former site manager Ellen Hale on July 7, 1999.

PCBs: At Stations MW118 - MW125, EPA requested sample collection for PAHs and pesticides/PCBs at all locations, and analysis at alternating stations (e.g., MW119, MW121, and MW123). In response, MWAC proposed to collect and archive samples for PAHs and pesticides/PCBs at these locations. EPA has considered MWAC's response, and continues to support its original approach with a slight modification. MWAC shall collect and analyze samples for PAHs and pesticides/PCBs at MW119 and MW121. The other samples will be analyzed for PAHs and pesticides/PCBs only if the metals in those samples were below SQOs and if adjacent samples were below the metals SQOs but exceeded SQOs for PAHs or Pesticides/PCBs. Better characterization of the organics detected in the composite sample will provide necessary information for cleanup, even if cleanup may be driven by mercury results alone.

EPA also requested that vertical distribution of PCBs be adequately characterized in areas where PCBs exceed the SQO. The proposed cores near B-10c (MW126 and MW127) do not include PCBs analysis for any core intervals below the surface. MWAC shall collect a subsurface sample for the R2 interval if the R1 above the SQO's for pesticides/PCBs. MW 127 will make vertical delineation of pesticides/PCBs possible.

Biological Testing - Chronic Measure: EPA recognizes that MWAC has revised the Round 1A benthic results as directed by EPA. However, MWAC continues to assert that TOC (rather than depth and grain size) should be the primary determinant of a benthic reference site. EPA has provided rationale and data that support a contrary position; MWAC has not offered data that support their assertion. A preponderance of evidence shows that TOC was not considered a determining factor in the selection of benthic community reference sites for other Commencement Bay Nearshore/Tideflats (CB/NT) problem areas (St. Paul Cap, Asarco, Thea Foss Waterway, Hylebos Waterway). Therefore, TOC will not now be used as a determining

factor in the Middle Waterway unless MWAC can demonstrate that a specific, quantifiable difference in TOC results in an altered community structure.

For example, on page 3 of MWAC's Response to EPA Technical Review, MWAC states that grain size and TOC indicate "consistent conditions" between MW034 and MW037. The TOC difference between these stations is 2 percent. The difference in elevation (a very important factor) between subtidal station MW034, at –11.7 ft, and intertidal station MW037, at –1.7 ft, was overlooked. Yet, MWAC asserts that MW202 is an inappropriate reference site for MW034 because of a TOC difference *also of 2 percent.* MWAC's application of its TOC criteria is inconsistent. The elevation of TOC to a primary determinant factor in the selection of reference sites is unsubstantiated by the literature or other CB/NT problem areas.

EPA continues to assert that MW202 is an appropriate reference site for MW034. However, EPA recognizes that MWAC has withdrawn other biological tests at the mouth of Middle Waterway and that MW034 alone would require full analysis of the appropriate reference station. In the spirit of compromise, EPA is willing to accept MWAC's proposal to use Neanthes as the chronic test at Station MW034.

As you know, EPA originally requested benthic infaunal analysis at MW042, MW044, MW045, and MW047 but accepted MWAC's use of Neanthes at three of the four stations (MW042, MW045, and MW047). MW044 exceeds the benthic AET for mercury of 2.1 ppm, therefore MWAC shall use benthic infaunal analysis at MW044. MW206 is an appropriate and similar benthic reference station

	Depth	% Gravel	% Sand	% Silt	% Clay	% Fines	% TOC
MW044	~ 4 ft	4.5	33.6	48.3	13.6	61.9	5.5
MW206	~ 5 ft	6.2	41.1	48.3	10	58.3	3.4

Dioxins: EPA does not accept the conditions MWAC proposes for sampling and analysis of sediments for dioxins. As you know, EPA is developing a dioxin cleanup level for the Olympic View Restoration Area based on background concentrations. EPA also is formulating a site-wide strategy and may require dioxin analysis in other areas of Commencement Bay/Nearshore Tideflats. Whether EPA will incorporate a sitewide sediment cleanup objective for dioxin into the ROD has not been determined.

The dioxin sample locations in EPA's last round of comments on the Round 1B Technical Memorandum were selected based on the assumption that dioxins may be associated with elevated levels of pentachlorophenol. As MWAC's condition #3 suggests, if sediments with elevated levels of pentachlorophenol are removed, it may not be necessary to assess dioxin levels.

The August 23 draft Round 1B Technical Memorandum has provided greater clarity on MWAC's preliminary remedial concept, and shows a potentially conservative dredge cut. MWAC is testing within the conceptual dredge plan near the shipyard to reduce volumes. MWAC also proposes to assess potential natural recovery in the Central Tideflats and is testing a large portion of the waterway head to determine sediment remedial volumes. Actual dredge volumes are not known, and a substantial volume of sediments may ultimately remain in the waterway. As you know, the absence of pentachlorophenol does not assure that dioxin is not present. For these reasons, EPA has revised its approach as follows.

MWAC shall collect surface samples for dioxin analysis at MW-034, MW-153, and MW-138. These samples are in areas that do not clearly require active remediation based on current data. The analysis of these samples shall be a first tier analysis, not conditioned upon other results. (Note: MWAC's proposed dioxin sample at MW157 was not shown on Table 9, but need not be collected).

At a reduced number of locations previously identified for collection of dioxin samples, MWAC shall collect and archive surface samples at MW111, MW132, MW135, and MW140, MW146, and MW154. Pentachlorophenol will be added to the list of parameters for Tier 1 analysis for those stations where Pentachlorophenol was not already included. Analysis of a given archived sample for dioxin will only be performed if all the Tier 1 analytes in that sample are below their respective SQOs. This is EPA's position in the absence of biological testing.

MWAC shall submit a SAP/QAPP amendment incorporating the analytical methods and QA/QC procedures for the dioxin analysis within 15 days of MWAC receipt of this correspondence.

EPA is prepared to analyze samples that MWAC collects or to collect and analyze the samples if MWAC is unwilling to comply with this direction. The costs EPA incurs for sampling and analysis of dioxin samples in Middle Waterway will be tracked as Middle Waterway Remedial Design Oversight costs. EPA reserves the right to analyze the archived samples collected by MWAC, regardless of whether the above conditions are met

Other required changes: MWAC shall move MW156 slightly closer to the bank in question and nearer the two outfalls identified in the Pre-RD Work Plan. EPA requests that the location be moved halfway between MW149 and MW150 and half the distance between MW150 and the current location of MW156. This location will still be in the proposed dendritic channel but closer to more of the B-3a segment (rather than at the northernmost end). P. 16, EPA #48.

Section 4.4, p. 4.10. The bulleted paragraph and Table 9 should include metals, not just mercury, as an analyte group for MW129 through MW131. Mercury may be a driver but zinc and copper were also found above SQOs.

EPA Comments Requiring Replacement Pages

P. 21, EPA #69. The bathymetric contours for Middle Waterway are not visible in the report figures nor are the contour labels (if any). EPA understands that the Hylebos reference station depths ranged from 4 to 6 ft MLLW, probably around 5 ft MLLW (based on a conversation with Gary Braun, Foster Wheeler Environmental Corporation). Reference station depth is of primary importance in determining an appropriate reference site, therefore, please clearly label the figure or provide the depth information elsewhere in either the text, tables, or data appendix.

Section 4.2, p. 4-4. Data gap No. 2 should specify that pentachlorophenol, not pesticides, was a chemical of concern (COC) in segment B-10b.

Section 4.3, p. 4.7. Adjacent segment B-10b had exceedances of metals and PAHs similar to B-10c but with a unique exceedance of pentachlorophenol, which is a focus of future sampling at MW127. (Note: Bank composite segment B-10c had a maximum phenol ER of 2.2, not 1.4.)

Section 4.5, p. 4-12. A fourth data gap should be added that recognizes the need to define the horizontal and vertical distribution of surface and subsurface COCs from the head of the waterway (near the City of Tacoma and DNR properties) that abuts bank segment B-8. The third bullet should include pentachlorophenol in the analytical suite at MW132, MW135, and MW140 to address concerns over potential dioxin contamination from Coast Craft.

Section 4.6. p. 4-14. The first bulleted paragraph should state that the core intervals will extend beyond the depth of subsurface contamination based on existing sediment data (e.g., Station TF-23 has COCs to 3 feet).

Section 4.8, p. 4-16. Data gap No.1 should include mercury as a potential source for recontamination.

EPA Editorial Comments and Suggestions

TBT: EPA recognizes that MWAC has revised Figure 14 (Preliminary Remediation Concept) to include locations with higher TBT levels in the proposed cleanup area. Because it appears that the areas with higher TBT levels will be remediated (i.e., vicinity of the marine railway), EPA will not require additional TBT characterization at this time. In response to MWAC's reference to West Waterway, EPA would like to note that it has explicitly stated that conclusions for the West Waterway may not be applied to other sites.

P. 13, EPA #39. EPA's proposed core (formerly MWAC's surface sample MW137) near MW050 was designed to identify the extent of subsurface contamination to the east and south of MW050. Without that information, EPA must assume that any subsurface contamination found by MWAC may extend to the head of the waterway and to the edge of the Middle Waterway Shore Restoration Project. Therefore, a rather large area toward the head of the waterway may be included with the problem area due to the lack of any Round 1B data to define the subsurface

extent. If MWAC wishes to minimize the risk of remediating the whole area, EPA strongly suggests that MWAC add a core between MW144 and MW050, with the top two intervals analyzed for metals and SVOCs and the two deeper intervals archived for analysis (to be analyzed if the R2 interval exceeds SQOs).

P. 12, EPA #37. EPA recommended a core sample at MW044 that MWAC declined to include, based on subsurface data available from HC-6. Station HC-6 is near the northernmost end of the abandoned barges, which does not serve to delineate spatial extent along the banks and barges south of MW044 toward the head of the waterway. MWAC may want to consider including a core at MW047 to be archived and analyzed if the chronic biological test fails.

P. 9, EPA #26. EPA recognizes that MWAC has revised Figure 14 (Preliminary Remediation Concept) to include MW029 in the remediation concept due to an exceedance at MW029. However, it is important to reiterate that since MWAC is not conducting biological testing at a number of stations (e.g., MW027, MW030, MW151, MW152, MW157), EPA will use chemical data for a given station in the absence of biological test results. In addition, EPA notes that MWAC's statement that MW026 and MW029 sediment was highly scoured and consolidated is contradicted by the field logs and grain size data. The field logs indicate a power grab was used for all surface stations in Area A, regardless of substrate conditions. The field log for MW026 shows that six of seven grabs were obstructed by debris (logs, metal debris, wood and rock, metal debris, cable, and rocks), not consolidated sediment. The field log for MW029 shows that sediment was collected in just two grabs and that sand and shell fragments, which were "easily scoured," were common. Furthermore, scoured substrate is typically composed of consolidated clay, coarse gravel, and cobble, without sands and silts. Grain size data for MW026 and MW029 show a complete range of particle sizes, including medium and fine material, that is not indicative of either scoured or consolidated sediment.

MW202 is within 3 ft of depth, 11 percent fines, and 2 percent TOC of either test station, suggesting an appropriate and similar reference station.

	Depth	% Gravel	% Sand	% Silt	% Clay	% Fines	% TOC
MW026	~ -25 ft	19.7	33.6	35.3	11.4	46.7	2.44
MW029	~ -24 ft	1.8	33.5	47.6	17.2	64.7	3.02
MW202	-22.0 ft	--	--	--	--	53.7	0.9

EPA Comments on Revised Final Round 1A Data Report (dated August 23, 1999)

In addition to MWAC's Final Round 1B Technical Memorandum, EPA reviewed the Revised Final Round 1A Data Report submitted on August 23, 1999. MWAC has addressed the majority of EPA's comments, and the data presented in the Revised Final Round 1A Data Report appear to be accurate. A few minor outstanding data accuracy issues were identified, as described in the comments below, which are referenced by the comment numbers provided in MWAC's response memorandum (dated April 16, 1999). EPA expects MWAC to submit the requested information within thirty (30) days of MWAC receipt of this correspondence.

Comment 17: Table 13 appears to reflect the validated contaminant mobility data for the site, as indicated in the response to comments. However, the data that were used to calculate the "Average of Thea Foss Composites" could not be located within the report. At a minimum, MWAC needs to provide the specific reference to the Thea Foss document(s) from which these data were obtained to allow for verification of the average values presented.

Comment 20: The response to comments indicated that "total effective mortality" results were used as the representative toxicity endpoint for the amphipod test (Tables 16 and 19). However, the reference performance standard and biological screening criteria for this bioassay are based on mortality alone, not effective mortality. Although the results of the tests do not change relative to the screening criteria, it is recommended that the mortality data, rather than effective mortality data, be presented in Tables 16 and 19 for consistency with the screening standards.

Comment 28: Final review of the data presented in Figure 5 versus the revised data tables provided by MWAC indicated that the percent fines value presented for the 4.7 to 10 foot depth interval for station MW037 (30.8) is incorrect and should be revised to 31.8 (per Table 7 data).

Comment 29: Final review of the data presented in Figure 7 versus the revised data tables provided by MWAC indicated that the percent fines value presented for the 8 to 12 foot depth interval for station MW029 (35.6) is incorrect and should be revised to 32.9 (per Table 7 data).

Comment 32: Final review of the data presented in Figure 8 versus the revised data tables provided by MWAC indicated that the percent fines value presented for the surface interval for station MW001 (11.7) is incorrect and should be revised to 11.8 (per Table 7 data).

Comment 35: Final review of the data presented in Figure 10 versus the revised data tables provided by MWAC indicated that the percent fines values for two stations (MW029 and MW037) should be revised in accordance with above Comments 29 and 28, respectively.

Additional Editorial Comment: Section 4.2.12 Tributyltin summarized non-detected TBT results for 10 of 17 samples. The correct numbers should be 8 of 16 samples, based on the Appendix D Analytical Data.

In addition to the above comments, EPA reviewed the Revised Final Round 1A Data Report to ensure MWAC's responsiveness to previously requested information. The following represents information that EPA requested in its EPA Technical Review letter of October 13, 1998 (italicized). Due to the delay in response, EPA expects that MWAC will provide the following information within thirty (30) days of MWAC receipt of this correspondence.

Comment 28: *Section 3.1 Estimated Volumes of Sediments Requiring Removal. Please provide an estimate of the volume expansion expected with dredging. This volume will be critical in determining dredge disposal options.* The original comment was not addressed. The estimate does not specify dredging (bulking) effects.

Comment 31: *Section 4.4, Dredgability, 2nd paragraph, 2nd sentence. It is assumed that the second sentence refers to clamshell dredging. Clarify the type of dredging. In the last sentence, please indicate that an option to water treatment may be incorporation of a sufficiently large retention pond to allow particulates to settle.* The comments were not addressed.

Comment 32: *Table 1. Include units with the concentration heading. Clarify if the absence of values in the table indicates that there were no exceedances or if no analysis was performed.* The table was resubmitted as Table 11 but the comments were not addressed.

Comment 34: *Table 4. Provide plots of analyte concentration versus pore volumes eluted so trends can be more readily observed.* The table was resubmitted as Table 15 but the comment was not addressed.

Comment 35: *Graph 2. Provide a footnote indicating what parameter is being presented and what the initial concentration was.* The comment was not addressed.

Attachment 8

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

September 16, 1999

Reply To
Attn Of: ECL-111

SENT BY CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Kim Maree Johannessen
Johannessen & Associates, P.S.
5413 Meridian Avenue North, Suite C
Seattle, WA 98103

-and-

David Templeton
Anchor Environmental
1411 4th Avenue, Suite 1210
Seattle, WA 98101

Re: EPA comments on Natural Recovery Sections of Final Round 1B Technical Memorandum (August 23, 1999) and SAP/QAPP Addendum (August 9, 1999)

In EPA's previous correspondence (dated September 10, 1999), EPA approved MWAC's Final Round 1B Technical Memorandum and SAP/QAPP Addendum with specified modifications, not including the natural recovery sections of those documents. EPA has reviewed MWAC's proposed natural recovery sections and this letter conveys our comments.

EPA authorizes MWAC to proceed with proposed natural recovery data collection, as planned, with the enclosed modifications required by EPA. EPA notes that this approval does not include MWAC's proposed use of sediment stakes. EPA is unclear how the data collected from sediment stakes will be used in the natural recovery assessment and how the proposed data collection will impact the overall time frame for remedial design. Therefore, before approving the use of sediment stakes, EPA requests a meeting with MWAC to further clarify this particular proposal and other natural recovery issues.

EPA expects to receive all requested revisions and replacement pages within forty-five (45) days of MWAC receipt of this letter. If MWAC intends to begin field work next week, please submit by COB Monday, September 20, 1999, MWAC's written commitment that all EPA recommendations will be fully addressed.

Finally, EPA notes a correction to the comments sent to MWAC on September 10, 1999. On page 1 of the PCBs section (last paragraph), the sentence should read "At Station MW127, MWAC shall collect and archive pesticides/PCB's samples at the R2 interval, to be analyzed for pesticides/PCB's if the R1 interval is below the SQO's for metals or above the SQO's for pesticides/PCBs."

Please contact Ted Yackulic at (206) 553-1218 or have David Templeton contact me at (206) 553-6511 if you have any questions regarding this letter. I look forward to meeting with you soon.

Sincerely,

Angela Chung

Angela Chung
Site Manager

Enclosures

cc: Elly Hale (EPA)
Ted Yackulic (EPA)
Alison Reak (RF Weston)
Steve Hoffman (URSG)
Russ McMillan (Ecology)
Helen Hillman (NOAA-EPA)
Bob Taylor (NOAA-Sand Point)

EPA Comments on Natural Recovery Sections of Final Round 1B Technical Memorandum (August 23, 1999) and SAP/QAPP Addendum (August 9, 1999)

General Note:
For this review, EPA's comments reprinted in the MWAC Response to EPA Technical Review were numbered sequentially and are referred to below (e.g., P. 1, EPA #2). In addition, references to the Final Round 1B Technical Memorandum are indicated below by section and page number (e.g., Section 4.4, p.4-9.).

Comments:
Section 5.2, p.5-5 to 5-8. MWAC proposes to use data from other waterways for input parameters such as gross sedimentation rate, net sedimentation rate, and others. In particular, MWAC proposes to use the Sitcum Waterway under-pier net sedimentation rates for the Middle Waterway slope and under-pier areas.

EPA's concerns with this section are as follows:

1) The document states that Sitcum under-pier rates will be used for Middle Waterway slope and under-pier areas. EPA requests that MWAC define "slope" and identify areas where the term is applied.

2) Some of the net sedimentation rates from the Sitcum Waterway are high due to the large resuspension rate in the Sitcum Waterway from boat activity. These values could overestimate the slope and under-pier net sedimentation rates in the Middle Waterway because Middle Waterway does not have the same boat conditions as the Sitcum Waterway (and, hence, not the degree of resuspension from the tideflat area and subsequent deposition in the under-pier areas).

Actual net sedimentation rates for subtidal areas in Middle Waterway would be the best rates to use. However, MWAC could demonstrate that boat activity in the Middle Waterway is similar to the boat activity in the Sitcum Waterway or perform an analysis of boat activity, energy, and particle resuspension as was done in Sitcum. In lieu of obtaining these actual rates, MWAC should consider net sedimentation rates from other waterways (i.e., Hylebos, Thea Foss) in addition to the rates from the Sitcum Waterway.

3) MWAC does not specify the sedimentation rates it will use for the tideflats area. EPA recognizes that MWAC has proposed the use of sediment stakes to gather data on net sedimentation rates in the tideflats, over an approximate one-year time frame. EPA acknowledges MWAC's effort to gather direct data, however, it is unclear what impacts the proposed one-year monitoring will have on MWAC's overall time frame for remedial design. EPA also is concerned that this relatively short time frame will not provide useful information regarding actual net sedimentation rates in the tideflats. MWAC may want to consider other options, such as reviewing the sedimentation rate data collected in the Simpson Shoreline Restoration Area. Although these data did not encompass the entire tideflats area, they may provide some insight to net sedimentation rates in a specified area

of the tideflats. As previously mentioned, EPA does not approve MWAC's use of sediment stakes for natural recovery assessment and requests a meeting with MWAC to further discuss these issues.

P. 12, EPA #36. EPA previously requested that MWAC add a core west of the centerline between stations MW126 and MW155 (currently MW158). This station would have provided more information regarding subsurface conditions. MWAC responded that, among other reasons, an additional core in the area seemed excessive with the addition of cores MW158 and MW153. Station MW158, a natural recovery core, does not include PAHs in the analysis or extend below 2 ft deep. There is very little subsurface information but what is available indicates PAH exceedences. As currently proposed by MWAC, MW158 would provide limited information to assess subsurface PAH and mercury contamination, which is known to exist at greater than 2 ft deep (see MW041, 3.5 ft-interval from MW040). Station MW159, as currently proposed, also will not provide subsurface information, and MW044 and MW047 are locations with high surface mercury levels. If these locations (MW044, MW047) fail biologically, determining removal volumes will require subsurface information.

Therefore, to provide more information regarding subsurface conditions, MWAC shall extend the MW158 natural recovery core to 5 feet and analyze at the R2 and R3 intervals for PAH's and mercury. EPA expects that surface results of MW039 will apply to MW158. MWAC also shall extend the MW159 natural recovery core to 5 feet and analyze the R2 and R3 intervals for mercury, if the surface exceeds SQO's or if MW044 or MW047 fail biologically. Since there are no surface data near MW159, MWAC should clarify how it will compare the surface results from the natural recovery samples at MW159 to the SQO's. In both natural recovery cores, MWAC shall collect core intervals of 3 cm in the upper portions and intervals of 5 cm lower in the cores.

Section 5.2, p.5-5. MWAC states that "net deposition will approach 100 percent of the gross sedimentation rate". This, therefore, assumes zero resuspension in the Middle Waterway, which is most likely not the situation. Since MWAC will have gross sedimentation and net sedimentation values to calculate resuspension rates, this sentence should be deleted.

P. 20, EPA #65. MWAC states that it will assess bioturbation rates by evaluating the mercury profile against historical profiles. MWAC states that this method has been employed in the Hylebos and Sitcum Waterways. EPA notes that only lead-210 analyses were reported as part of the Sitcum natural recovery analyses.

Attachment 9

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

September 20, 1999

Reply To
Attn of: ORC-158

Kim Maree Johannessen
Johannessen & Associates, P.S.
5413 Meridian Avenue North, Suite C
Seattle, WA 98103

Re: Approval of Final Round 1B Technical Memorandum sampling and field activities pursuant to In the Matter of: Middle Waterway Problem Area of the Commencement Bay nearshore/Tideflats Superfund Site, Administrative Order on Consent for Pre-Remedial and Remedial Design Study, U.S. EPA Docket No. 10-97-0096/CERCLA 1 (the "AOC")

Dear Kim:

This letter confirms our resolution of certain issues related to Middle Waterway Action Committee's ("MWAC") proposed Round 1B sampling and field activities. This letter also provides approval of the Final Round 1B Technical Memorandum ("Tech Memo") as modified by the Environmental Protection Agency ("EPA") comments dated September 10 and 16, 1999 and under the conditions stated herein. EPA assumes MWAC will implement its sampling and field activities consistent with the conditions of this letter.

MWAC raised certain issues in response to EPA comments on the Tech memo. We were able to resolve all of these issues, with the exception of those related to dioxin sampling and analysis, during our meeting of September 17, 1999. In regards to dioxin sampling, EPA has agreed to table resolution of the dioxin issues. This will allow EPA and MWAC to consider the preliminary Round 1b sample results and the dioxin strategy for Commencement Bay when these issues are re-examined. This may result in EPA significantly modifying its approach to dioxin issues in the Middle Waterway.

During our meeting of September 17, 1999 and follow up discussions on September 20, 1999, MWAC and EPA reached agreement as follows:

CONTAMINANT SAMPLING

1. MWAC will not collect surface samples for dioxin at this time. EPA and MWAC will discuss the need to collect and analyze samples for dioxin after review of the preliminary Round 1b sample results, and the dioxin strategy for Commencement Bay. EPA will then determine whether it is necessary to sample surface sediments and analyze the collected samples for dioxin.

2. As outlined in EPA's September 10 letter, MWAC will collect surface samples at six locations (MW-111, MW-132, MW-135, MW-140, MW-146, and MW-154) and analyze these samples for pentachlorophenol. MWAC will revise table 9 of the Tech Memo to include pentachlorophenol analysis at these locations.

B. NATURAL RECOVERY

1. EPA has not approved MWAC's use of sediment stakes for collecting information upon which to evaluate sedimentation rates in the tideflats area. However, MWAC may proceed with placement of sediment stakes as proposed in its Tech Memo and SAP/QAPP Addendum. As agreed, EPA and MWAC shall meet to discuss the validity of this proposed method and other natural recovery issues.

2. MWAC shall extend the core depth at MW-158 and MW-159 to depths of five feet. At both of these locations, two additional core intervals (R2 and R3, respectively) will be collected below the MWAC proposed core depth. At each location, the R2 interval shall be analyzed for mercury and the R3 interval shall be analyzed for mercury if the SQO is exceeded in the R2 interval.

3. At station MW-158, MWAC shall analyze the R2 and R3 intervals for PAHs to determine the vertical extent of contamination.

Approval by this letter incorporates the required changes EPA articulated in its September 10 and 16, 1999 letters that were not addressed in this letter. Accordingly, MWAC is required to change the Tech Memo and the Revised Final Round 1A Data Report as modified by these comment letters.

EPA and MWAC agreed that MWAC shall provide EPA with replacement pages to the Tech Memo within forty-five (45) days of the date of this letter (November 4, 1999), and with replacement pages for the Revised Final Round 1A Data Report within thirty (30) days of the date of this letter (October 20, 1999). MWAC

and EPA also agree that this letter shall be included in attachment 7 to appendix C of the Tech Memo. MWAC is not required to submit a SAP/QAPP addendum as requested in EPA's September 10, 1999 letter at this time.

EPA herein approves MWAC's request to extend the due date for the Round 1 Data Report by thirty (30) days. Accordingly, this report is due on February 17, 2000, one hundred and fifty (150) days from the date of this letter. EPA notes that this extension may limit MWAC's ability to meet current schedules for the biological assessment and combined disposal.

In addition, in order to facilitate the discussions related to dioxin sampling, MWAC will provide EPA with preliminary lab results for 1B sampling efforts within ten (10) of MWAC's receipt of these results. EPA will provide MWAC with a copy of the dioxin strategy for Commencement Bay after it is approved by EPA.

Except as expressly articulated, nothing in this letter modifies the terms and conditions of the AOC and both MWAC and EPA retain whatever rights, authorities and obligations contained in the AOC.

We appreciate your efforts in resolving these issues. If you have any questions regarding this letter call me at 553-1218.

Sincerely,

Ted Yackulic
Assistant Regional Counsel

cc: Russ McMillan
Helen Hillman
Bob Taylor

APPENDIX D

ADDENDUM SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

VIA HAND DELIVERY

MIDDLE WATERWAY ACTION COMMITTEE
c/o Johannessen & Associates, P.S.
5413 Meridian Avenue North, Suite C
Seattle, WA 98103-6138

Telephone: (206) 632-2000
Facsimile: (206) 632-2500

August 9, 1999

Angela Chung, Project Coordinator
U.S. Environmental Protection Agency
Region 10 (ECL-115)
1200 Sixth Avenue
Seattle, Washington 98101

RE: Draft Addendum Sampling and Analysis Plan and Quality Assurance Project Plan
Middle Waterway Pre-Remedial Design and Remedial Design Study

Dear Ms. Chung:

As requested in EPA's July 7, 1999 letter, the Middle Waterway Action Committee (MWAC) has attached a Draft Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan Addendum (QAPP). This SAP and QAPP Addendum provides additional information specific to potential Round 1B field activities not already presented in the EPA-approved Middle Waterway Problem Area SAP and QAPP, dated April 13, 1998 (Foster Wheeler Environmental, 1998b). The SAP and QAPP Addendum will be Appendix D to the Final Round 1B Technical Memorandum. The Final Round 1B Technical Memorandum will provide the basis for additional data collection needs, sample locations and numbers and is scheduled to be submitted in compliance with Section XII of the Administrative Order on Consent (AOC) for the Middle Waterway Problem Area of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site on or before August 23, 1999.

If you have any questions, please do not hesitate to contact me at (206) 287-9130 (e-mail: dtempleton@anchorenv.com).

Sincerely yours,

Bruce McDonald FOR

David Templeton

cc: (*all via regular mail*)
Middle Waterway Action Committee
Gary Braun, Foster Wheeler Environmental Corp.
Ellen Hale, EPA
Ted Yackulic, EPA
Allison Reak, Roy F. Weston, Inc.

DRAFT

APPENDIX D

Sampling and Analysis Plan
and
Quality Assurance Project Plan (Addendum)

August 9, 1999

Appendix D
Sampling and Analysis Plan and Quality Assurance Project Plan Addendum

D.1 PURPOSE AND SCOPE OF THIS DOCUMENT

This Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) Addendum provides additional information specific to Round 1B field activities not presented in the EPA-approved Middle Waterway Problem Area SAP (Foster Wheeler Environmental, 1998b) and QAPP (Foster Wheeler Environmental, 1998c), dated April 13, 1998. The Final Round 1B technical Memorandum provides the basis for additional data collection needs, identifies sample locations, numbers, and other details of Round 1B sampling and analysis activities.

D.2 ORGANIZATION OF DOCUMENT

This addendum SAP and QAPP addresses the following Round 1B activities:

- Natural Recovery Sampling
- Marine Railway Structure Survey
- Subsurface Sampling and Well Installation/Development
- Sequential Batch Leaching Test Procedure
- Collection of Dioxin Samples
- Geotechnical Explorations

D.3 NATURAL RECOVERY SAMPLING

D.3.1 Sediment Stakes. To help obtain information about the net sedimentation rate in the tideflats and how the sediment surface changes over time, sediment stakes will be advanced in the tideflats area. Approximately 8 stakes will be driven into the sediment such that they will not reasonably be relocated by natural processes. The locations of the stakes will be surveyed after placement and each time the sediment levels at the stakes are measured using a theodolite, level and rod, or similar equipment. The sediment levels at the stakes will be recorded and surveyed approximately once a quarter at a low tide condition over an approximate one-year time frame. Observations about local scour, should that occur, will be recorded. If local scour is observed, the bottom of the scour depression will be measured as well as the height of the surrounding unaffected sediment surface. The tentative locations of the stakes are illustrated on Figure 17 of the Final Round 1B technical Memorandum. An example monitoring sheet is provided in Table D-1.

Table D-1 Example Sediment Stake Monitoring Sheet

Stake No.	Time	Tide	Easting (surveyed)	Northing (surveyed)	Z (surveyed)	Sediment Surface (relative)	Observations

D.3.2 Core Sectioning. Two natural recovery cores will be advanced in the tideflats area. The cores will be advanced with the Mudmole™ and collected and processed as described in Section D.5 and Attachment 1. Each core will be advanced 100 cm below the sediment surface, if possible. One surface interval from one of the two cores will be analyzed for specific gravity; selected other intervals will be analyzed for total mercury and total solids. The approximate locations of the natural recovery cores are illustrated on Figure 17 of the Final Round 1B technical Memorandum. An example of how the sediment intervals may be sectioned and analyzed is provided in Table D-2.

Table D-2 Natural Recovery Intervals and Core Section (Example)

Interval (cm)	Total Hg	Total Solids	Specific Gravity
0-4	X	X	X
4-6	X	X	
6-8	X	X	
8-10	X	X	
10-12	X	X	
20-24	X	X	
30-34	X	X	
40-44	X	X	
50-54	X	X	
60-64	X	X	
70-74	X	X	
80-84	X	X	
90-94	X	X	

D.4 MARINE RAILWAY STRUCTURE SURVEY

D.4.1 Test Pits. One test pit will be advanced within the marine railway with a small excavator (Bobcat or similar with approximately 1 cu ft bucket) at approximately elevation +7 feet MLLW. The test pit will be dug to a depth of approximately 3 feet and will be approximately 3 feet wide. It will begin at the concrete block bulkhead and end on the other side of the marine railway between the railway and the pier. The depth of penetration of the concrete block wall and foundation characteristics will be examined, if possible, and documented. The test pit will continue perpendicular to the rails to the far side of the rails. The anticipated configuration of the

marine railway (Figure 1) will be confirmed and typical measurements and spacings will be obtained. This will likely require digging parallel to the rails in the area between them to determine the lateral spacing of the pile caps.

It is anticipated that the sediments at this location will be of sufficient strength to support the excavator. If the excavator sinks into soft sediments, plywood sheets or steel plates will be used to support the excavator during the construction and backfilling of the test pit. All excavated materials will be stockpiled adjacent to the test pit and will be backfilled into the excavation when all measurements and observations have been completed. The test pit will be backfilled prior to being inundated by the incoming tide.

The location of the test pit will be determined using the DGPS equipment described in the SAP, and its dimensions will measured using a fiberglass tape.

No chemical testing of excavated sediments will be performed.

D.4.2 Probe Survey. Probes (e.g., steel rods, PVC poles, or similar) will be used to probe other portions of the marine railway to confirm similar construction dimensions of the structure. Probes will be advanced on 3 transects spaced approximately 6 feet apart and with approximately 6-inch spacing on each transect to a depth of approximately 2 feet. Information gathered during the probing (e.g., relative resistance, contact with timber, etc.) will be recorded in a field log book.

D.5 SUBSURFACE SAMPLING

Subsurface sampling methods are described in detail in the SAP, including vibracore sampling (SOP 11) and hollow stem auger drilling (SOP 12).

Due to site constraints, including waterfront structures and the tideflats, MWAC has decided to employ Pentec Environmental's MudMole™. The MudMole™ is a patented sediment vibracore collection system. A description of this vibracore is provided in Attachment A.

Well installation and development during hollow stem auger drilling is detailed in SOP 16 (Attachment B).

D.6 SEQUENTIAL BATCH LEACHING TEST PROCEDURE

Sequential Batch Leaching Test (SBLT) cores will be collected anoxically. The cores will be archived at 4° C for up to one year prior to extraction in an anoxic environment to create a composite representative of potential remedial action areas. The SBLT procedure, including analytical procedures are included in the SAP and QAPP. The test would be performed using an

appropriate leachate media (e.g., deoxygenated site water) and would be performed in general accordance with the procedures outlined in the Corps' Waterways Experimental Station guidance (Corps, 1996).

D.7 COLLECTION OF DIOXIN SAMPLES

Assuming EPA and MWAC agree upon conditions for triggering dioxin analysis, the collection of sediment samples for potential future analysis of dioxin will be performed in accordance with the following additions to the SAP and QAPP:

- Sediments samples will be collected in pre-cleaned, laboratory certified glass containers (16 oz).
- Sediments will be maintained at 4^0C prior to being frozen for up to 1 year (holding time is 1 year).
- If the conditions agreed upon by EPA and MWAC are triggered, a SAP amendment incorporating the analytical methods and QA/QC procedures included into the EPA-approved Olympic View Resource Area SAP and QAPP will be submitted to EPA.
- If the analysis of dioxin is performed, EPA will be provided the selected laboratory SOP and QAPP, including quality assurance objectives.

D.8 GEOTECHNICAL EXPLORATIONS

This section describes procedures and equipment for hollow-stem auger drilling and physical testing necessary to support geotechnical evaluations discussed in the Round 1B Technical Memoranudm. SOP 12, included in the SAP (Foster Wheeler Environmental, 1998b), describes hollow stem auger drilling.

D.8.1 Sampling Methods. Geotechnical borings will be drilled by hollow-stem auger methods to a depth of approximately 20 feet below the deepest adjacent dredge cut elevation to support an evaluation of potential sheet pile design and overall slope stability. Drilling will be attempted at each of the planned locations; however, it is possible that drilling will be ineffective if debris is encountered. If drilling fails at a selected location (refusal or no sample retrieval), one alternative location will be selected in the field and drilling at that new location will be attempted. If the second attempt fails, no further drilling effort will be required for that location.

All drilling will be conducted in the presence of an MWAC field representative, who will prepare a detailed boring log for each exploration (Figure 6 of the SAP). Sampling will be performed in accordance with American Society for Testing and Materials (ASTM) methods. Soil samples will be visually classified in the field in accordance with ASTM D 2488. The volume of water added during drilling, if any, will be recorded. Only clean water from a known potable source would be

added to the borehole. Standard Penetration Tests (SPTs) will be obtained using the methods given in ASTM D-1586-84. The standard method allows different drilling methods and states:

> *Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable.*

Shelby tube samples of fine-grained soils (i.e., silt and clay) will be obtained using the methods given in ASTM D-1587-94. As with the SPT, ASTM allows flexibility in drilling methods. Shelby tube samples will be obtained by pushing an open-ended tube into the soil and retrieving the sample. In very soft soils, a piston sampler (e.g., Gus or Osterberg type device) may be necessary to achieve good recovery. Based on experience with similar soil conditions, it is expected that a piston sampler may be needed when sampling the upper 2 to 5 feet of marine sediments.

The split-spoon sampler is a heavy steel cylinder with an expanding plastic catcher at the lower end. The sampler is driven down into the soil ahead of the auger to retrieve a sample, using a drop hammer of known weight. The split-spoon sampler is 2 inches in diameter and 18 inches in length. A 140-pound hammer dropping 30 inches onto the end of the drilling rods drives the sampler. The number of blows required to drive the sampler the final 12 inches is the Standard Penetration Resistance. This resistance provides a relative measure of the density of granular soils and the consistency of finer-grained cohesive soils. When this type of sampler is retrieved, the casing can be split in half to provide visual examination of an 18-inch-long soil core. The core may then be logged and sampled in accordance with the needs of the program. SPT blow counts and samples will be collected at 2½-foot-depth intervals for the upper 10 feet and at 5-foot-depth intervals below 10 feet depths.

Samples obtained from the split-spoon sampler will be used primarily to log the borings. The depth, color, texture, and other visual physical properties of each stratum in the core will be recorded for use in developing a soil profile in the sampling area. Soil from each split-spoon will be placed into 16-oz plastic jars for possible physical testing.

Shelby tubes are thin steel or stainless-steel cylinders which can be driven into the soil ahead of the auger. After being pushed into the soil, Shelby tube(s) are retrieved from the boring and sealed using plastic or Teflon end caps and tape to prevent leakage during transport to the laboratory. The samples are not mixed or transferred from the tube(s) until they reach the testing laboratory where they may be removed whole or tested in place in the tube for various physical properties.

The near-surface samples may be too soft to be sampled with a split-spoon or Shelby tube sampler. Therefore, there will be a piston sampler, such as a Gus or Osterberg sampler, in the

field. These types of samplers are effective in recovering soft soil and will be used to sample the upper 2 to 5 feet, if necessary.

Location control will be performed using DGPS equipment in accordance with the SAP. Sample documentation and management will be performed in accordance with the SAP.

Physical property analysis of soil will be conducted on selected samples to determine site geologic character and engineering properties of soil. Water content, grain size distribution, specific gravity, and Atterberg limits will be used to classify soil. Pocket penetrometer, torvane, consolidation, and triaxial shear are engineering tests that will be used in the geotechnical engineering evaluation (Table D-3).

Table D-3 Geotechnical Tests and Soil Sample Volumes

Test	Method	Sampler Type and Quantity
Water Content	ASTM D 2216	S/S – ½ lb.
Atterberg Limits	ASTM D 4318-95a	S/S – 1 lb.
Grain Size, inc. 200-Wash	ASTM 422	S/S – 1 lb.
Specific Gravity	ASTM D 854-92	S/S – ½ lb.
Consolidation	ASTM D 2435-90	Shelby – 6 in.
Triaxial Shear, unconsolidated, undrained	ASTM D 2850-95	Shelby – 6 in.

S/S -- Split-spoon Sampler
Shelby – Shelby Tube

Soil samples from the borings will be taken to a physical laboratory and analyses conducted for physical characteristics and geotechnical engineering properties. It is assumed that no chemical analyses will be performed. Table D-3 provides the required volume of testing samples for each.

- ***Water Content Determination*** As soon as possible following their arrival in the laboratory, water contents will be determined for most samples recovered in the explorations in general accordance with ASTM D 2216. The results of these tests will be plotted at the respective sample depth on the exploration logs. In addition, water contents are routinely determined for samples subjected to other testing to allow for dry weight normalization.

- ***Atterberg Limits*** Atterberg limit analysis will be completed on selected samples of fine-grained soil in general accordance with ASTM D 4318-95a. Atterberg limits, which include the liquid limit, plastic limit, and the plasticity index, are used to define plasticity characteristics of clays and other cohesive soil. Atterberg limits determination cannot be effectively completed on soil with low cohesive properties or high sand content. The

results of the Atterberg limits analyses and the plasticity characteristics will be summarized in terms of a plasticity index as related to the liquid limit.

- ***Grain-Size Distribution*** Soil samples will be visually classified in the field. Grain size distribution will be analyzed on representative samples in general accordance with ASTM D 422. Wet sieve analysis will used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The size distribution for particles smaller than the No. 200 mesh sieve will be determined by the hydrometer method for a selected number of samples.

- ***200-Wash*** Select samples will be subjected to a modified grain size classification known as a 200-wash. The samples are "washed" through the No. 200 mesh sieve to determine the relative percentages of coarse- and fine-grained material in the samples. The tests will be performed in general accordance with ASTM D 1140.

- ***Specific Gravity*** Specific gravity analysis will be completed on selected samples in general accordance with ASTM D854. Specific gravity is an engineering property used to assess the density of site soils.

- ***Pocket Penetrometer and Torvane*** The pocket penetrometer and torvane procedures provide quick approximate tests of the consistency (undrained shear strength) of a cohesive soil sample. The pocket penetrometer device consists of a calibrated spring mechanism which measures penetration resistance of a 1/4-inch-diameter steel tip over a given distance. The penetration resistance is correlated to the unconfined compressive strength of the soil, which is typically twice the undrained shear strength of a saturated, cohesive soil. The torvane device consists of a 1-inch-diameter plate with eight equally spaced and radially arranged 1/4-inch vanes. The vanes are pressed into the soil and the device is rotated. The vanes force a shear failure to take place over the area of plate face. The resistance at failure, as measured by a calibrated spring, correlates to the undrained shear strength of the sample tested. The exploration logs will show the results of any pocket penetrometer and torvane tests completed on samples.

- ***Consolidation Testing*** Consolidation tests will be run on selected samples of fine-grained materials to determine if these materials will consolidate under potential loading. The one-dimensional consolidation test provides data for estimating settlement. The test is performed in general accordance with ASTM D 2435. A relatively undisturbed, fine-grained sample is carefully trimmed and fit into a rigid ring with porous stones placed on the top and bottom of the sample to allow drainage. Vertical loads are then applied incrementally to the sample in such a way that the sample is allowed to consolidate under each load increment. Measurements are made of the compression of the sample (with time) under each load increment. Rebound is measured during the unloading phase. In

general, each load is left in place until the completion of 100 percent primary consolidation, as computed using Taylor's square root of time method. The next load increment is applied soon after attaining 100 percent primary consolidation. For selected tests, loads are left in-place for as long as 24 hours to record secondary consolidation characteristics. The test results are plotted in terms of axial strain and coefficient of consolidation versus applied load (stress).

- ***Triaxial Shear Testing*** Selected material obtained from Shelby tube samples will be tested to determine the shear strength. These data will provide a basis for evaluation of slope stability and shoring design. The triaxial unconsolidated undrained compression test estimates the undrained shear strength of the soil. This test will be performed in general accordance with ASTM D 2850. A relatively undisturbed fine-grained sample is trimmed to a length of about 6 inches, encased in a rubber membrane, and placed in the triaxial cell. An all-around confining pressure is applied hydraulically, but the sample is not allowed to consolidate, and no back pressure is applied. An axial load is then applied at a constant strain rate to the sample without allowing drainage from the specimen. The stress-strain behavior is recorded until failure occurs. The failure stress is generally taken as the maximum load on the sample or the load recorded at 20 percent strain, whichever is greater. The test results will be plotted in terms of axial strain versus deviator stress. The shear strength will be considered to be one-half the maximum stress difference based on the $\Theta = 0$ concept and a total stress analysis.

D.9 REFERENCES

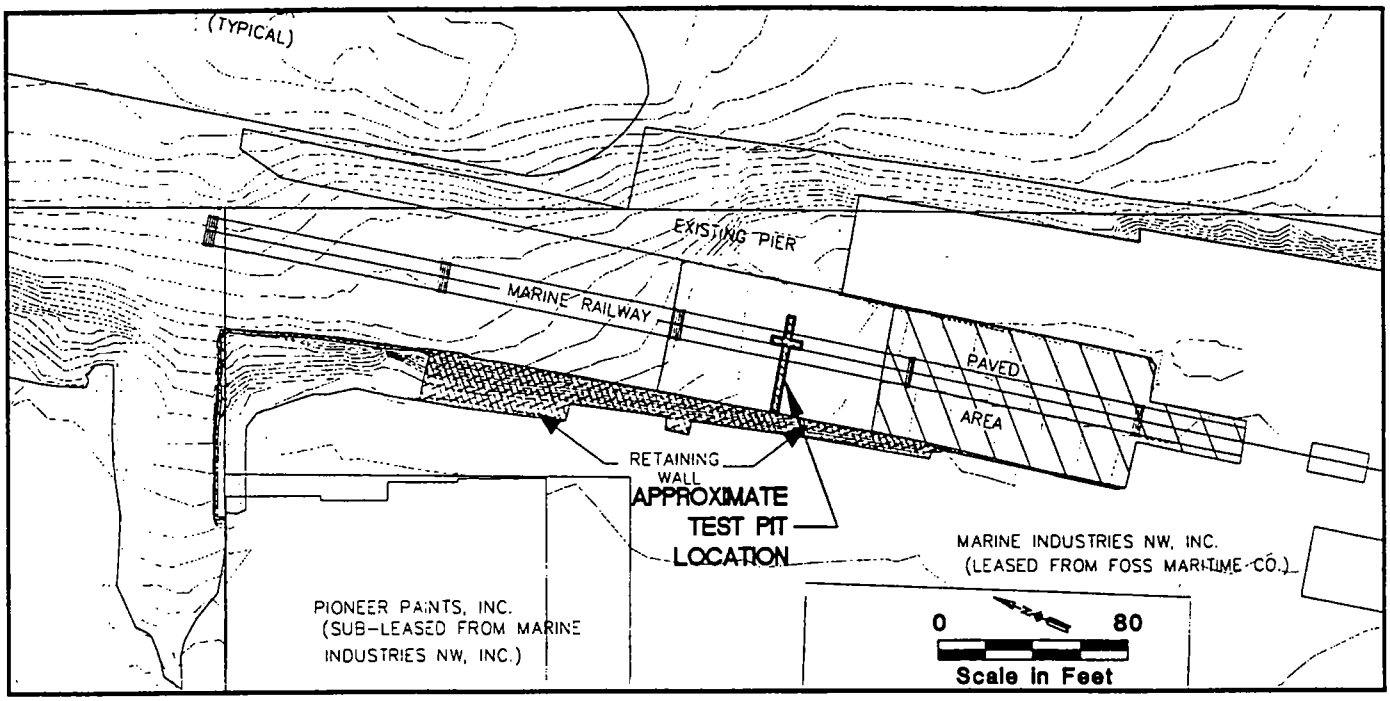
ASTM (American Society for Testing and Materials). 1996. 1996 Annual Book of ASTM Standards. Section 4—Construction, Volume 04.08 Soil and Rock (I): D420-D 4914, Volume 0.4.09 Soil and Rock (II): D4943—latest; Geosynthetics. ASTM, West Conshohocken, PA.

Foster Wheeler Environmental. 1998b. Sampling and Analysis Plan. Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee. Bellevue, WA.

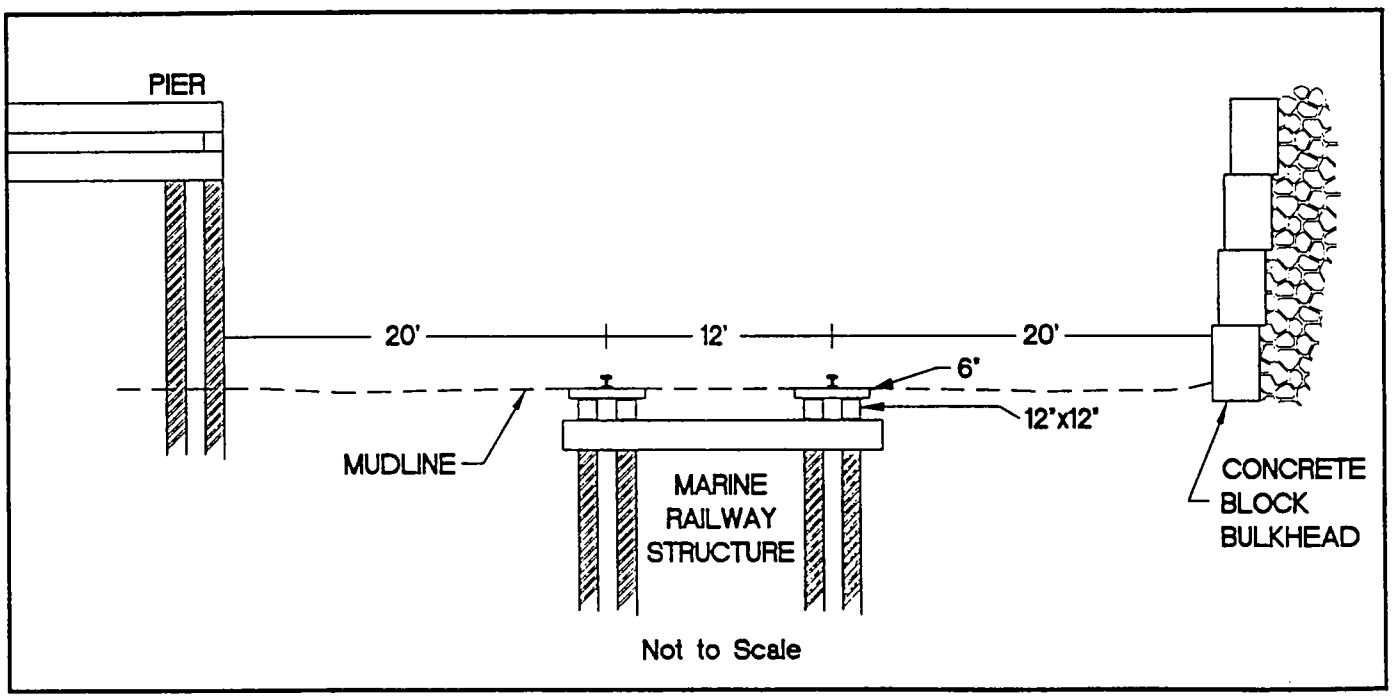
Foster Wheeler Environmental. 1998c. Quality Assurance Project Plan. Prepared by Foster Wheeler Environmental for Middle Waterway Action Committee. Bellevue, WA.

NAVFAC (Naval Facilities Engineering Command). 1982. Design Manual 7.1, Soil Mechanics. Department of the Navy, Naval Facilities Engineering Command, Alexandria, VA.

Corps. 1996. Leachate Testing and Evaluation for Estuarine Sediments. Myers, Tommy E., Brannon, James M., Tardy, Barbara A., and Townsend, Dan M. U. S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg MS.



PLAN VIEW



TYPICAL CROSS SECTION

ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

MIDDLE WATERWAY

08/06/99 MWW005-01 99-046-01 Draft

Figure 1
Middle Waterway
Marine Railway Structure

Attachment A

Description of Pentec Environmental, Inc. MudMole™

The MudMole™ sediment sampler can be considered to be a hybrid of between a vibracorer and an impact corer. The core barrel of the MudMole™ is advanced into the sediment by means of a pneumatically operated hammer operated at about 5 Hz. The hammer is linear, in that approximately 70 percent of the energy is imparted on the downward stroke. Because the MudMole™ operates at approximately 5 Hz (the lower end of the frequency of a vibracorer) it can be considered as a linear vibracorer. The advantage of this system is that forces perpendicular to the plane of the core barrel are virtually eliminated and there is little liquifaction of the sediment core. In addition, since the advancement of the core barrel in the sediment is not dependent on the mass of the sampler, this system is relatively light weight and highly portable.

The MudMole™ has distinct advantages over traditional vibracoring devices. As described above, the MudMole™ core sampler uses high amplitude – low frequency impact to drive the core tube and provides approximately 300 blows per minute, which usually provides faster and deeper core penetration than "typical" vibracore systems. The advantage of this approach is that the interior portions of the sediment are not disturbed by excessive liquefaction that can occur with vibracore systems. This allows stratigraphic layers in the sediment core to be easily detected.

The core tube assembly consists of a 4-inch-square aluminum tube. The use of a square tube provides approximately 20 percent more sediment per linear foot of core than a typical 4-inch outer-diameter round core tube. The Pentec core tube provides approximately 2.8 liters of sediment per linear foot of recovery, whereas a 4-inch outer-diameter round core tube will provide only 2.2 liters per foot of recovery. The additional volume of sediment obtained from the Pentec core tube can mean the difference between obtaining sufficient sediment for analysis with one core or having to take a second core.

Pentec utilizes two styles of core tubes: removable-side and solid-side. The removable-side style of core tube is 7-ft in length and is constructed with a stainless steel sheet-metal cover attached to one side of the 4-inch-square aluminum tube. By removing several machine screws, the cover can be lifted off, exposing the sediment inside of the tube. This system allows the sediment to be inspected and sampled with very little disturbance compared to methods of extruding the sediment from the core tube. Removable-side core tubes are reusable, thus reducing material costs. For cores longer than 10-ft, solid-side aluminum tubes are used to provide necessary tube strength. Sediment is removed from the core by using a circular saw to cut away one side of the tube. This process only takes a few minutes and again allows sediment to be sampled with a minimum of disturbance.

Certain types of analyses require that sediment be maintained in an anaerobic condition from collection to processing in the laboratory. To protect the sample from contact with air, Pentec uses solid-side core tubes that are fitted with specially designed molded silicone rubber caps and

plugs. At the laboratory, the core can be extruded inside of a nitrogen-purged glove box ensuring that the sample is not exposed to air (e.g., creation of SBLT composite sample).

Detailed information on penetration and recovery can be collected incrementally throughout the core. These data can not be collected using traditional coring systems.

The Pentec bore log summarizes relevant information about the collection of the core sample. This log is produced in the field and accompanies the core sample when the sample is transferred for processing. Recorded on the log are sample location information, sample station information (e.g., time, date, water depth, and length of the core tube), and incremental penetration and recovery information. Provided below is a description of information provided on the bore log.

Pentec Technologies Bore Log

Date: 4/14/98 Time: 14:00

Project: 312-006 Water Depth: 34 ft

Station Name: 33-08 Rep 2 Coordinate Datum: NAD 83 (A)

Recorder: CJW Geographic State Plane Zone: WA South

Tube Length: 10.6

	Deg.	Min.	Sec.	
W. Longitude:				Northing: 715939
N. Latitude:				Easting: 1167727

Comments: sticky clay at tip of tube

Clock Time	Elapsed Time	(B) Penetration	(C) Recovery Tape Reading	(D) Interval	(E) Interval Recovery (ft)	(F) Interval Percent Recovery	Interval Penetration Rate (ft/min)	Core Section Intervals: In-situ Segment (ft)	Distance from Top of Tube
0:00		0.0	11.6					1	4.1
0:00		2.3	9.1	0-2.3	2.50	109%		2	5.2
0:00		4.1	7.1	2.3-4.1	2.00	111%		3	6.3
0:00		6.0	5.6	4.1-6	1.50	79%		4	7.4
0:00		8.0	4.5	6-8	1.10	55%		5	8.2
0:00		10.1	3.7	8-10.1	0.80	38%		6	9.0
0:00			0.0					7	9.6
0:00			0.0					8	10.1
0:00			0.0					9	10.5
0:00			0.0					10	

(H) On Deck

Top of Sediment	Recovery	Percent Recovery
3.0	7.6 ft	75%

(G) *In-situ*

Penetration	Recovery	Percent Recovery
10.1	7.9 ft	78 %

(I)

Description:

A Core station information.

B Penetration—the cumulative measurement of penetration (e.g., the second measurement in this column is 2.3 ft which is the distance the core has penetrated)

C Recovery Tape Reading—the cumulative measurement of the distance from the top of the core tube to the top of the recovered sediment.

D Interval—the penetration interval (e.g., the first entry in this column is 0-2.3 which indicates the interval was 0 to 2.3 ft of penetration)

E Interval Recovery—the amount of sediment recovered in the interval (e.g., the first entry in the column is 2.5 which indicates there was 2.5 ft of recovery in the 0 to 2.3 ft interval)

F Interval Percent Recovery—the percent recovery for the interval (e.g., the percent recovery for the 0 to 2.3 ft interval was 109 percent)

G *In-situ*—summary of the penetration and the *in-situ* recovery for the core (i.e., the penetration was 10.1 ft with an overall recovery of 78 percent [7.9 ft of sediment])

H On Deck—summary of the recovery of sediment after the core is retrieved compensating for the loss of sediment that may occur during the core extraction process. In this example, the on-deck recovery was 7.6 ft. This shows a loss of approximately 0.3 ft of sediment from the core tube during extraction.

Attachment B

Hollow Stem Auger Well Installation/Development

Standard Operating Procedure 16

STANDARD OPERATING PROCEDURE 16
HOLLOW STEM AUGER WELL INSTALLATION/DEVELOPMENT

Required Equipment

- SAP
- Field logbook and boring log forms
- Indelible black-ink pens and markers
- Hollow stem auger drill rig
- Tremie pipe
- Weighted tape or tag-line
- Assorted tools (shovels, wrenches, etc.)
- Annular materials including silica sand, bentonite pellets and chips, and bentonite grout
- Monitor well materials including flush-threaded Schedule 40 PVC (2") riser, Johnson well screen (10 slot, or equivalent), end caps, and stainless steel centralizer
- Completion materials including steel monuments, concrete mix, 2" x 6" forms, and bucking posts, if necessary
- Pump
- Turbidity meter
- DOT-approved 55-gallon drums or Baker tanks
- Decontamination equipment as specified in SOP 7

Typical Procedures

Note: Monitor well installation will comply with the Minimum Standards for Construction and Maintenance of Wells, Chapter 173-160 WAC.

Installation:

1. Remove the center plug and rods from the borehole. Depth measurements will be taken during the installation procedure and verified by the rig geologist. Record measurements on the as-built form and in the field logbook.

2. Backfill from bottom of boring to within six inches from the bottom of screen interval with annular materials representative of formation materials.

3. Lower the decontaminated well casing string into the borehole through the hollow stem augers.

4. Install one centralizer above the filter pack and bentonite plug, approximately 8' above the top of the screen.

5. Install the silica sand filter pack from 6" below the screen to a minimum of 3' above the screen. Use a tremie pipe, if possible, to install the filter pack.

6. Install a bentonite pellet plug (5' minimum) above the filter pack. Use a tremie pipe, if possible, to install the plug. If the tremie cannot be used because of bridging, then slowly gravity feed the pellets. At least one hour will be allowed for the bentonite plug to hydrate.

7. Install a cement/bentonite grout (or bentonite chip) seal from the top of the bentonite plug to the frost line (approximately 6" below grade). Hydrate the bentonite chips with potable water.

8. Cut PVC riser (for surface completions). Record cut length in field logbook.

9. Install concrete pad (minimum 3'x3'x6") and locking protective monument.

10. Stamp well with identification information.

Development:

1. Calibrate field instrumentation for measurement of water parameters including temperature, pH, specific conductance, and turbidity.

2. Begin development of well by purging and surging or by bailing.

3. Contain well development water.

4. Record parameter data and approximate volumes of water produced on well development form.

5. Continue development of well until discharge is clear (non-turbid) and parameters have stabilized within +/- 10%.

6. Remove development equipment and clean up site.

7. Decontaminate all equipment in accordance with SOP 7.

8. Document activities in the field logbooks.

WELL DEVELOPMENT LOG

Well No.: _____

Site: _____

Contractor: _____

Geologist: _____

Total Well Depth: _____ (ft) Casing Diameter: _____ (in)

Depth to Water Below Top of PVC Before Development: _____ (ft)

Stick Up of PVC Casing: _____ (ft) Length of Water Column: _____ (ft)

Gallons of Water in Well (0.6 gal/ft for 2 inch well) _____ (ft)

Method of Development: _____

Range and Average Discharge Rates: _____

Total Volume Removed: _____ (gallon)

Time	Volume Removed (gal)	Temp (oC)	pH	Specific Conductance (umhos)	Turbidity (NTUs)	Dissolved Oxygen (mg/L)	Remarks	

DBJ:8/4/99